

Climate Analysis of Number of very hot days (>30°C)

Horizons Region, New Zealand

Climate Change Projections from CCAM-Downscaled CMIP6 Simulations

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For

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1 Executive Summary

Extreme heat events, defined here as the annual number of very hot days where maximum temperature exceeds 30°C (TX30), are a highly sensitive indicator of climate change, with implications for public health, infrastructure, agriculture, ecosystems, and wildfire risk. For the Horizons region, this synthesis assesses TX30 from 1986–2005 through three future periods (2021–2040, 2041–2060, 2080–2099) and across four emissions scenarios (SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5), drawing on six downscaled CMIP6 models.

TX30 is historically rare in the Horizons region, averaging less than one day per year even in the hottest localities, almost exclusively confined to summer. All models and scenarios robustly project increases in the number and spatial extent of very hot days. Increases are initially modest—typically less than one additional day per year through 2040—but accelerate by mid- and late-century, especially under higher emissions. By 2080–2099, median projections range from 1–4 extra very hot days per year under lower emissions (SSP1-2.6), 1–12 days region-wide under intermediate emissions (SSP2-4.5, SSP3-7.0), and as much as 10–20+ days per year in the north and inland areas for SSP5-8.5. The largest increases are consistently found in sub-regions such as NorthernZone-Taumarunui and Puketoi ki Tai.

Seasonality is extremely robust: projected changes are entirely driven by summer, with minor increases in autumn and negligible changes in winter and spring. The spatial and temporal evolution of hotspots reveals significant new exposure for the region, with the greatest amplification in already warmer areas. Inter-model agreement is high on the direction and seasonal pattern of change, though local magnitude is disputed, especially in identified hotspots.

Confidence is extremely high that the Horizons region will experience significant increases in very hot days, with the scale and regional distribution dictated substantially by future emissions. As these rare extremes become more routine, the need to adapt infrastructure, urban planning, emergency services, and land management is critical. Uncertainty remains in quantifying the most extreme local changes, but the risk of more frequent and intense heat events is unavoidable without strong global mitigation. Full sub-reports and visuals are available on request from Bodeker Scientific.

2 Introduction

With global average temperatures rising due to increases in greenhouse gas concentrations, the frequency of extreme heat events has increased worldwide. In the Horizons region, historically sheltered from regular high temperature extremes, understanding potential future changes in the annual number of very hot days (TX30, defined as days exceeding 30°C) is fundamental for risk assessment and adaptation planning.

This synthesis report collates and interprets findings from detailed sub-reports, which examine the historical distribution of TX30, project changes under four Shared Socioeconomic Pathway (SSP) emissions scenarios, capture their evolution over near, mid, and late-century periods, and assess inter-model agreement and associated uncertainties. The objectives are to

1. Delineate TX30's baseline spatial and seasonal distribution,
2. Quantify projected changes and their time evolution,
3. Evaluate robustness and uncertainty of results across models and scenarios,
4. Identify hotspots and sub-regions at greatest risk, and
5. Characterise the nature and sources of projection uncertainty.

Historically, very hot days are rare in the Horizons region. However, model projections strongly indicate their frequency will increase, with the scale and spatial pattern determined largely by emissions scenario and future period. Substantial increases, especially in summer, are virtually certain by late century under higher



emissions. This will impact human health (via heat stress and mortality), agriculture (crop stress, pasture decline), infrastructure (roads, power), ecosystems (drought and fire risk), and social services.

Adaptation considerations must focus on heat-resilient urban form and infrastructure, targeted health responses for vulnerable populations, revised agricultural and water management, and enhanced emergency preparedness. Early-warning systems, community education, and cooling shelters may become increasingly crucial. Land-use planning should anticipate increased fire weather risk and altered habitat suitability for native species. As most risk emerges in summer, seasonal health and operational preparedness are particularly pertinent. The degree of these impacts, and the adaptation burden required, will be defined by the emissions pathway followed globally.

The sub-reports contain detailed data, sub-regional assessments, ensemble spread analysis, and visuals underpinning this synthesis and are available from Bodeker Scientific on request.

3 Understanding Number Of Very Hot Days (>30°C)

The 'number of very hot days' (TX30) is a climate index tallying the number of days per year when maximum temperature exceeds 30°C at a given location. Calculation is straightforward—a daily maximum temperature is compared against the threshold for each day of the year, and the annual total is reported as days/year.

TX30 is primarily governed by large-scale climate drivers (regional mean temperature), local physiography (elevation, distance from coast, urban effects), synoptic weather (heatwaves, blocking highs), and land-atmosphere feedbacks (soil moisture, drought). Increases in mean temperature—resulting from heightened greenhouse gas concentrations—shift the entire temperature distribution upward, so intense high temperature events become more frequent. At the climatic margins, a small mean shift can produce large increases in TX30 occurrences because the frequency distribution's high-temperature tail moves beyond the threshold more often.

Short-term variability (e.g., El Niño–Southern Oscillation) can cause marked year-to-year fluctuations, but long-term change is dominated by emissions trajectory and associated regional warming. In New Zealand, and specifically the Horizons region, TX30 is modulated by topography (mountain shadow, altitude), proximity to the westerly flow, and consistent strong seasonality (highest in summer, negligible in winter). Urban development and local land cover may amplify rates of extreme heat via the urban heat island effect and reductions in evapotranspiration, but at a regional scale, external temperature forcing is dominant.

Because TX30 is a threshold-based metric, even modest increases in average temperature can sharply raise its annual incidence, especially in regions where historical values were rare and close to the threshold. As such, TX30 serves as a sensitive indicator of shifting heat-related risks and provides a clear benchmark for adaptation and public health 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.

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)

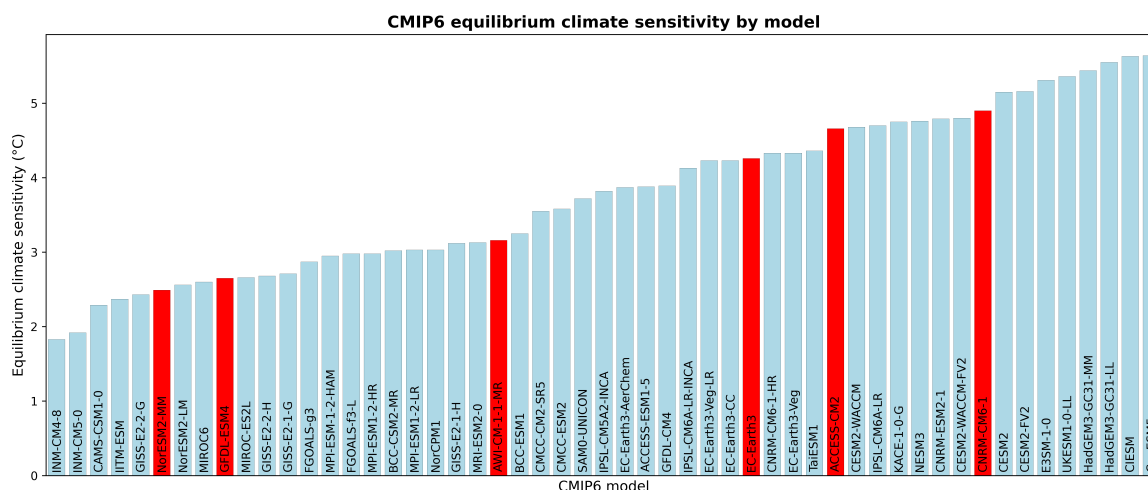


Figure 1: The location of the six guiding CMIP6 models across the full range of equilibrium climate sensitivities (ECSs) of all 53 CMIP6 models. The original of this figure can be downloaded [here](#).

All projections were evaluated relative to a baseline period of 1986–2005. Although the radiative forcing (the rate at which energy is being added to the climate system compared to the pre-industrial baseline) increases to 2.6 W m^{-2} under SSP1 by 2100, to 4.5 W m^{-2} under SSP2 by 2100, to 7.0 W m^{-2} under SSP3 by 2100, and to 8.5 W m^{-2} under SSP5 by 2100, one should not expect that there will always be a consistent (monotonic) increase or decrease for some climate variable from SSP1-2.6 to SSP2-4.5 to SSP3-7.0 to SSP5-8.5 since the pathways to that 2100 end point can be very different, and over the near-term to mid-century, natural variability can dominate the climate signal; often the climate signal only emerges later in the century. This is demonstrated in Figure 2. It is clear from this figure that both over the near-future and mid-century, the year-

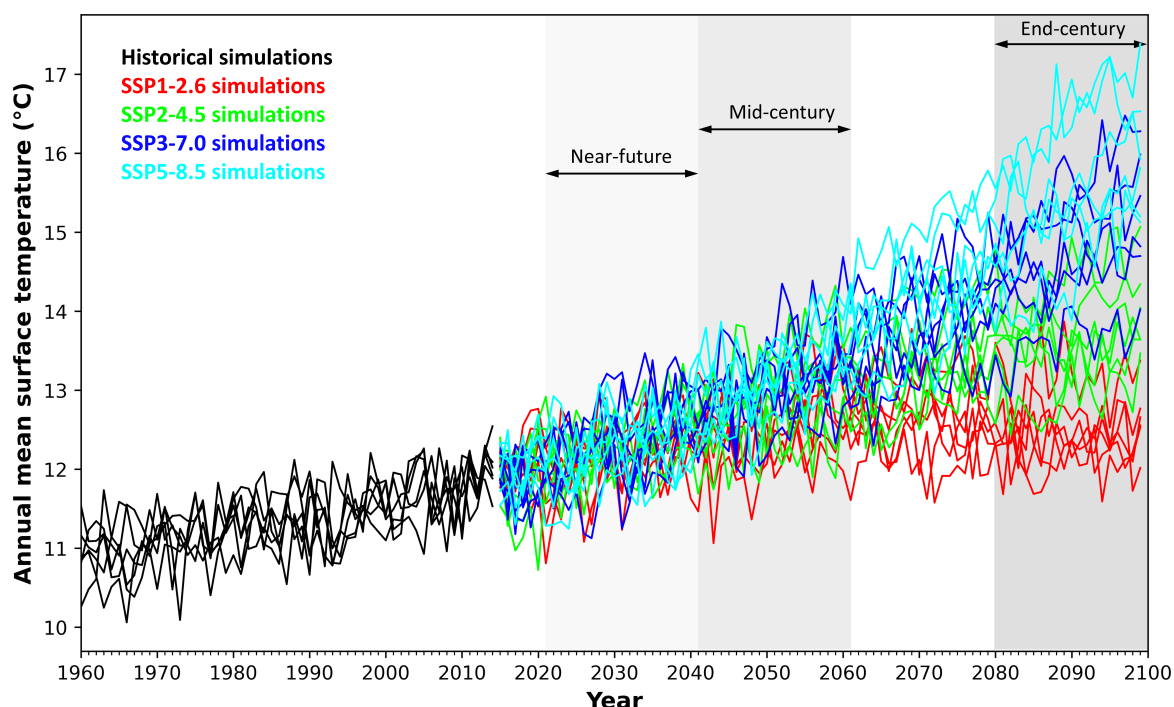


Figure 2: Annual mean temperature time series extracted from the six different model simulations, for the Horizons region, for the historical baseline (black traces) and for the four different SSP scenarios (SSP1-2.6 in red; SSP2-4.5 in green, SSP3-7.0 in blue and SSP5-8.5 in cyan). Also shown are the three different analysis periods that are considered below. The original of this figure can be downloaded [here](#).

to-year variability (unforced climate variability), and inter-model spread, obscures any statistically significant separation of the projections under the four different SSPs.



The availability of a set of six ensemble members, rather than relying on a single simulation, is a key strength of the modelling framework used in this assessment. 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 TX30-specific report. Uncertainty probability density functions (PDFs) generated using this method appear in many of the plots shown herein.

5 Number Of Very Hot Days (>30°C) Climatology: 1986 to 2005

The CCAM simulated number of very hot days (>30°C) fields, averaged over the period 1986–2005, are shown in Figure 3. 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

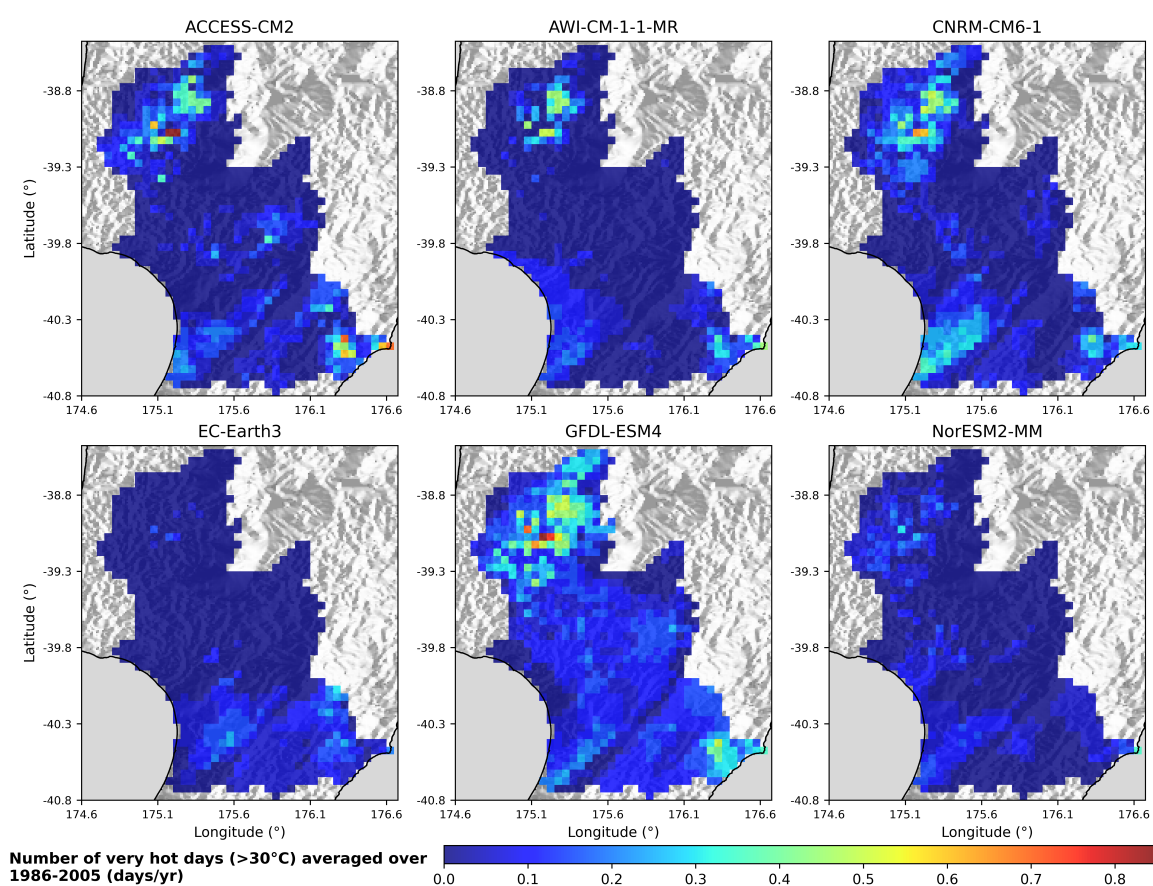


Figure 3: Number of very hot days (>30°C) fields as simulated by the CCAM model and averaged over the period 1986 to 2005. The original of this figure is available [here](#).

each field and the multi-model mean are shown in Figure 4. The multi-model mean number of very hot days (>30°C) fields, averaged over the period 1986–2005, for each season, are shown in Figure 5.

Climatological analysis for the baseline period (1986–2005) demonstrates that very hot days are exceptionally rare across the Horizons region. All six CMIP6-based models, dynamically downscaled by CCAM, agree that annual averages almost never exceed 0.1 days per year. In the multi-model mean, even the hottest localised patches—chiefly in northwestern and some southeastern lowlands—barely approach 0.5 days per year, meaning most locations experience TX30 events less than once every few years.

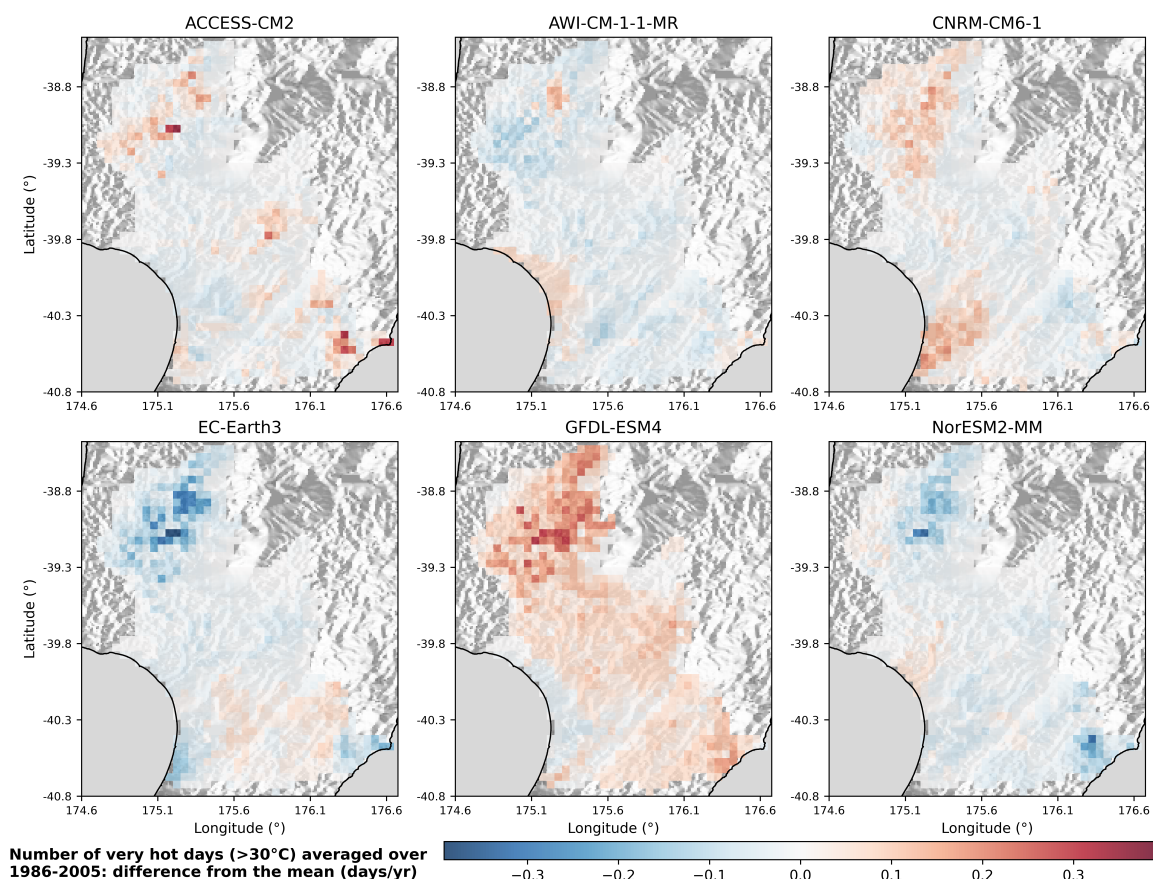


Figure 4: Differences from the multi-model mean. The original of this figure is available [here](#).

Spatial structure is shaped by topographic and coastal influences: areas removed from elevation and close to the interior are marginally warmer. However, the difference between the ‘hottest’ and ‘coolest’ sub-regions remains very small in absolute terms. Seasonal breakdowns confirm that TX30 events are virtually restricted to summer (DJF). In autumn (MAM), only a handful of southern or interior grid cells reach even minimal frequencies, while winter (JJA) and spring (SON) have essentially no such days at all. This pronounced seasonality is physically expected given regional temperature cycles and is replicated consistently across models.

Inter-model agreement is very high at the regional scale: maps of each model’s deviation from the multi-model mean show only local, spatially scattered differences below 0.3 days/year. Standard deviations across models are similarly low, and the pattern of disagreement is spatially random, not systematic. The R^2 statistics for spatial agreement, while moderate (reflecting some uncertainty in fine-scale patterning), further underline that broad climatological features are robustly simulated—local hot spots are modelled similarly, with any discrepancies restricted to subgrid detail.

In summary, baseline climatology confirms that very hot days are not a regular climatic feature of the Horizons region, only arising as rare, localised, and strongly summer-limited events. The rarity shown in historical observations is unequivocally supported by all models, validating both their suitability for projection and the unique vulnerability posed by climate change-induced increases.

6 Near-Future Projections (2021–2040)

In the near-future period (2021–2040), all model projections and ensemble statistics point to a likely increase in the number of very hot days (TX30: days >30°C) across the Horizons region, though this change is modest in both magnitude and spatial extent. The increases are most evident in low-elevation and inland sub-regions,

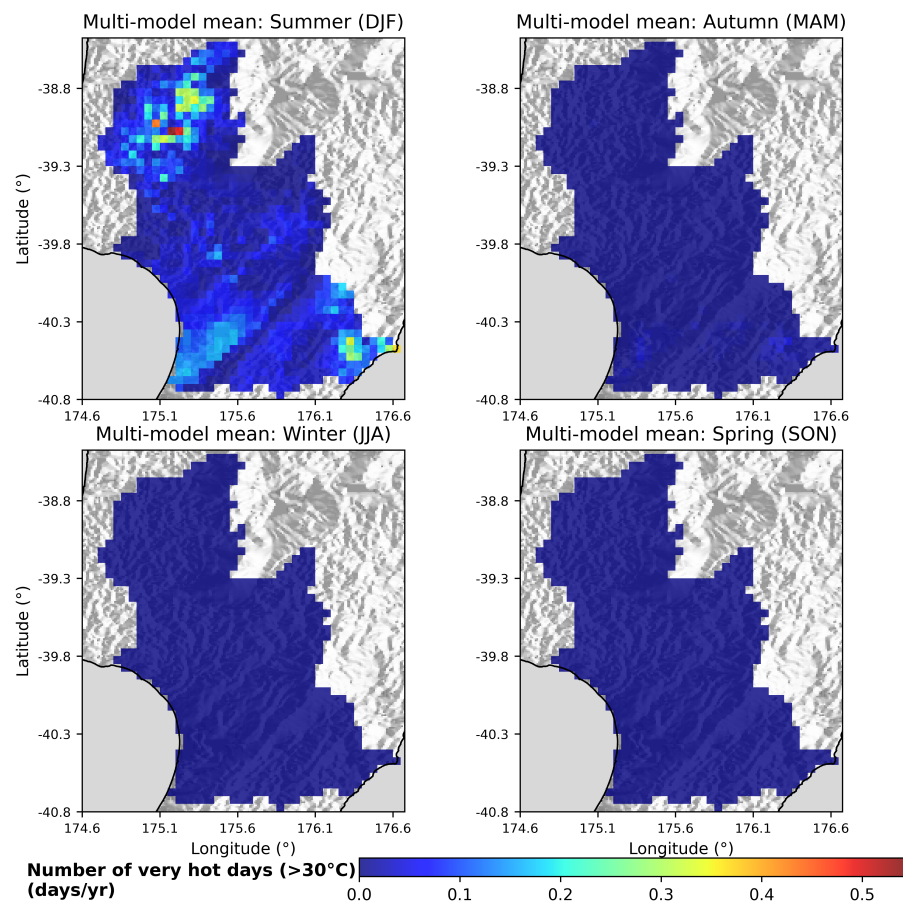


Figure 5: Multi-model mean number of very hot days (>30°C) fields for each of the four seasons. The original of this figure is available [here](#).



with hotspots in places such as Puketoi ki Tai, NorthernZone-Taumarunui, and Middle Manawatū–Rangitīkei. Even in these areas, the projected average increase is typically less than half a day per year, with ensemble maxima rarely exceeding two additional days annually in localised hotspots. The models show high agreement on the direction of change (i.e., an increase), but moderate differences exist in the spatial detail and precise magnitude, reflecting uncertainty in local-scale projections. Seasonality is pronounced; nearly all projected increases occur in summer (DJF), with virtually no change expected during winter or spring and negligible changes in autumn, confirming that climate-driven intensification of extreme heat remains overwhelmingly a summer phenomenon. Inter-model spread is moderate, with agreement highest in the regional and seasonal signal rather than local details. Overall, the likelihood of a widespread and significant increase in very hot days region-wide by 2040 is low, but isolated summer increases—while still modest—are deemed likely, particularly in previously warmer areas. The scenario-dependent nature of these changes is present, but irrespective of SSP, most models robustly signal an uptick in very hot summer days, setting the stage for further increases in subsequent decades. Local adaptation planning should focus on summer extremes, especially in interior sub-regions where modelled changes converge.

6.1 SSP1-2.6: Very likely, modest summer increases; regionally patchy, low magnitude

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 6. The multi-model mean changes

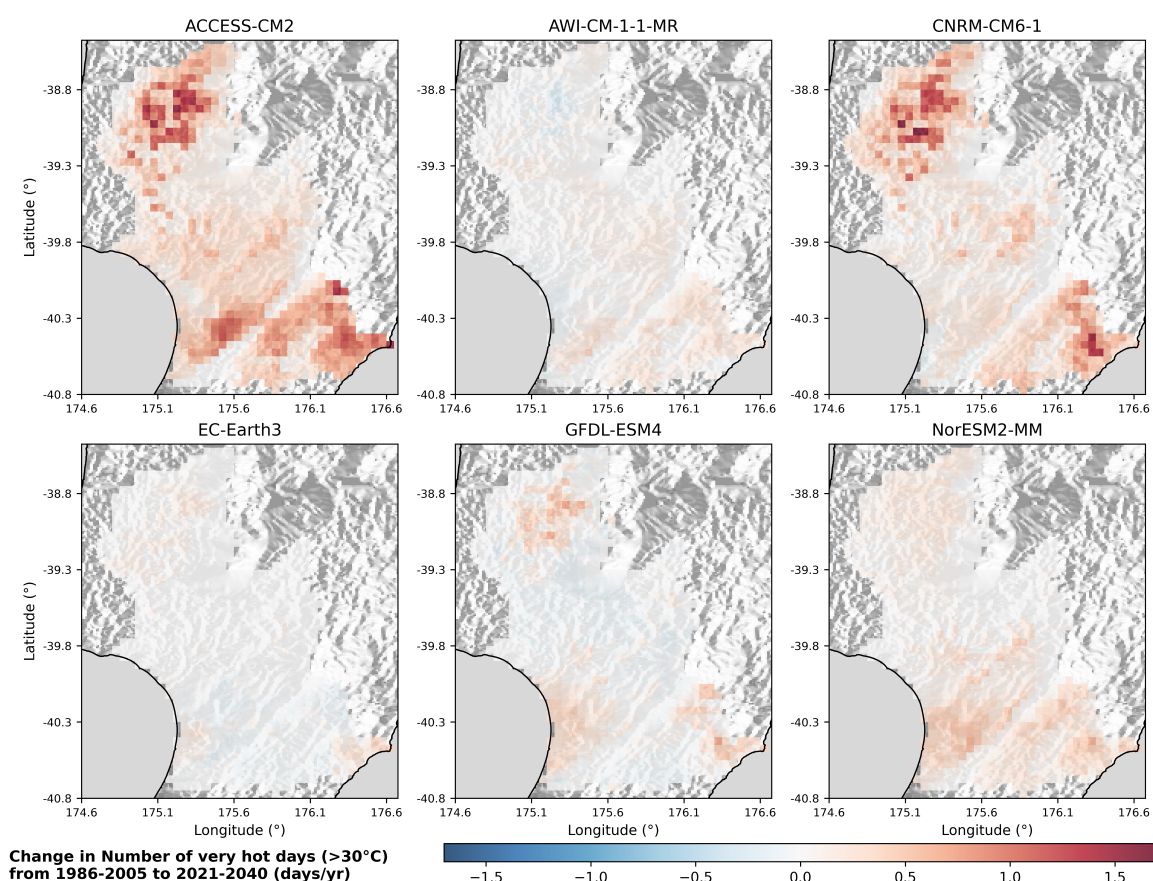


Figure 6: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 7.

For SSP1-2.6, which represents a low-emissions and high-mitigation scenario, projections for the near-term (2021–2040) show a very likely but modest increase in the annual number of very hot days (TX30, >30°C) for

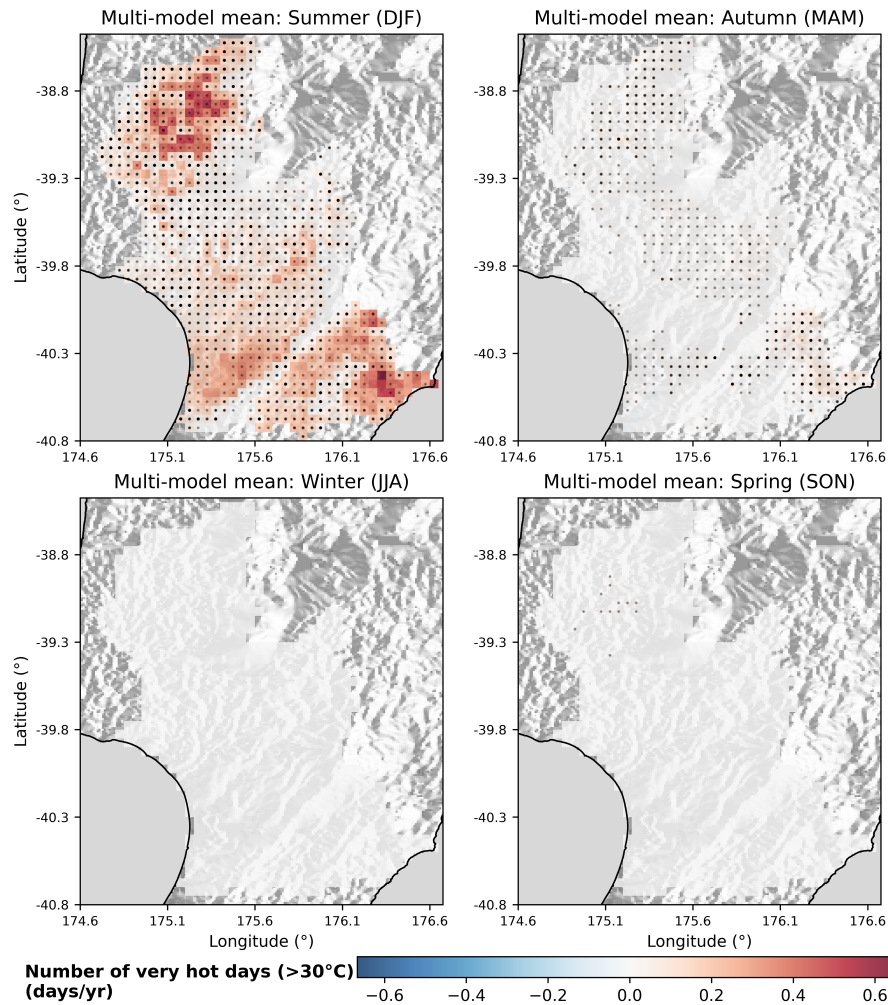


Figure 7: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six 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](#).



the Horizons region. The absolute increase remains low, with the multi-model mean indicating small changes across most of the region and a few localised hotspots approaching half a day per year. Spatial patterns within the models highlight low-elevation inland areas—particularly Puketoi ki Tai and select parts of Whanganui-Manawatū Lakes and Middle Manawatū–Rangitikei—as sites of greatest projected increase. These areas show the largest mean increases, with ensemble maxima suggesting that in rare seasons, up to two additional very hot days could occur locally. However, across most of the region, changes stay well below one extra day per year. Seasonality is extremely pronounced: essentially all projected increases are restricted to summer (DJF) with virtually no change outside of this season. Models agree strongly on the summer focus and the absence of change in winter and spring, but show only weak-to-moderate agreement on fine spatial details of where in the region increases may be most pronounced (spatial R^2 for summer around 0.19). Inter-model spread persists in the magnitude and placement of hotspots, and some sub-regions see little-to-no change or a minor reduction in the lowest model projections. Notwithstanding this uncertainty, there is extremely high confidence that by 2040, the overall region will experience more very hot days, though the practical impact remains limited by the low absolute baseline. Model agreement on the sign of change is good at the regional scale; finer details should be interpreted with caution.

6.2 SSP2-4.5: Likely small, summer increases; spatially patchy, modest in magnitude

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 8. The multi-model mean changes

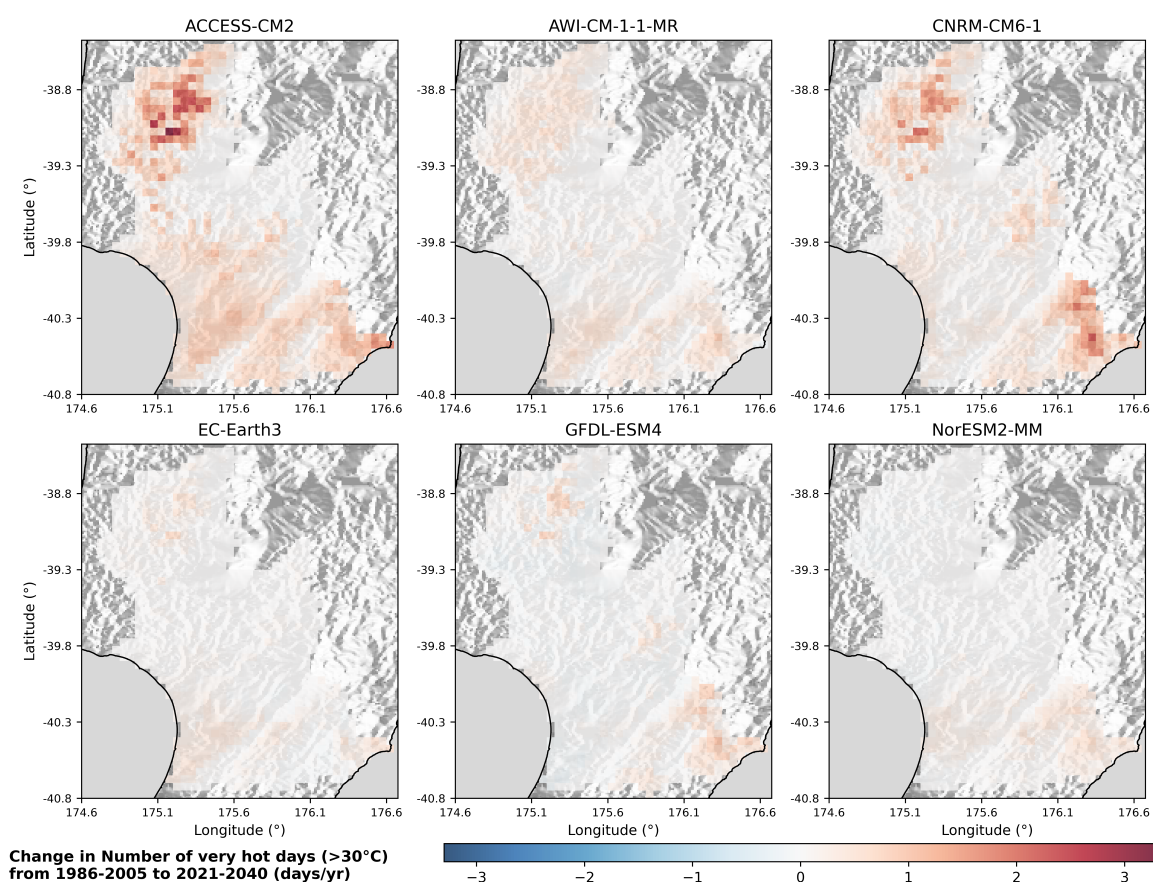


Figure 8: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 9.

Projections for SSP2-4.5, a moderate emissions scenario, indicate a likely and geographically variable increase

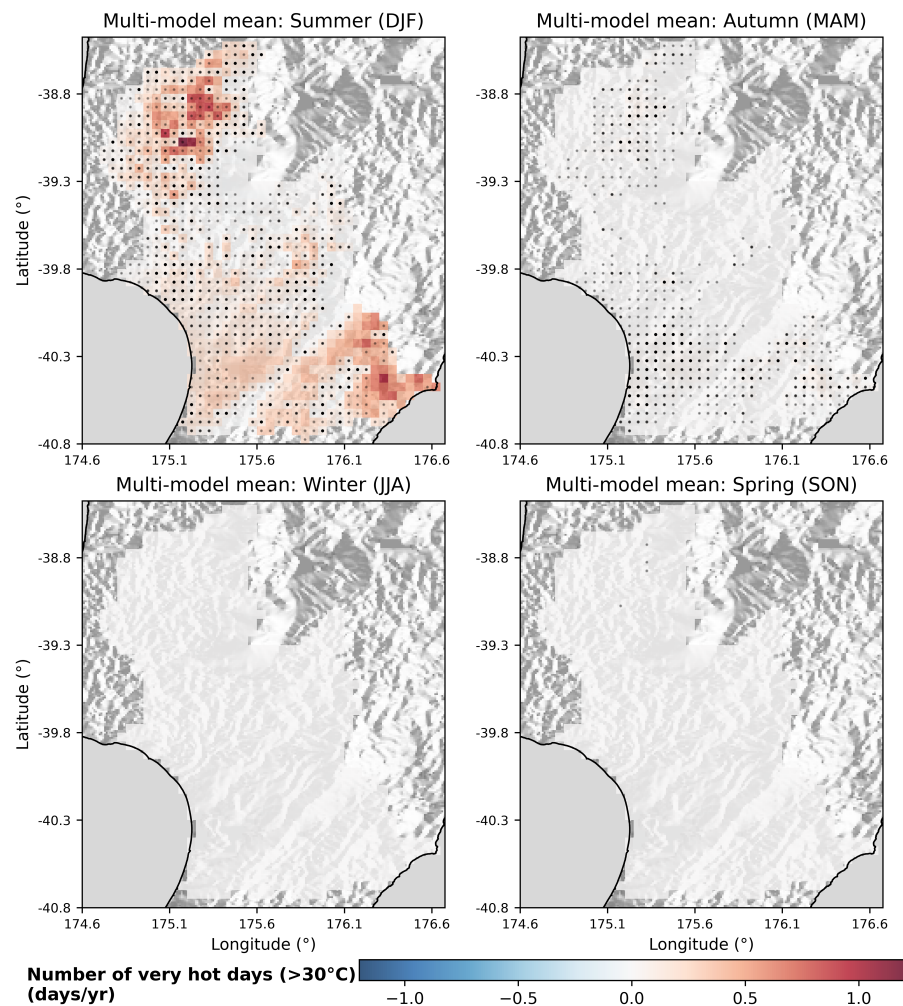


Figure 9: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the six 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](#).

6.3 SSP3-7.0: Very likely modest, localised summer increases; moderate regional signal

Figure 10 displays six maps showing the change in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 for different climate models. The models are ACCESS-CM2, AWI-CM-1-1-MR, CNRM-CM6-1, EC-Earth3, GFDL-ESM4, and NorESM2-MM. The maps cover the region from 174.6 to 176.6 longitude and -40.8 to -38.8 latitude. A color bar at the bottom indicates the change in days per year, ranging from -3 (blue) to 3 (red).

in the number of very hot days ($>30^{\circ}\text{C}$), for each season, are shown in Figure 11.

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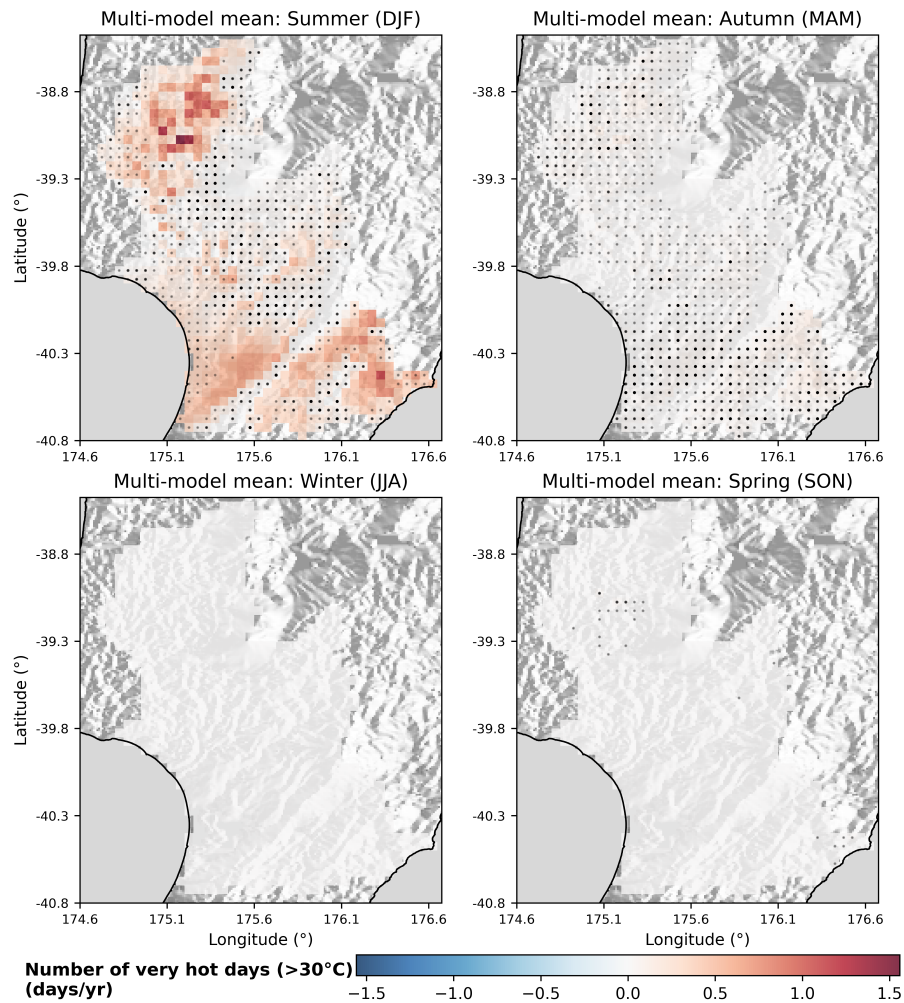


Figure 11: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



2021–2040 period. The largest increases occur in the same sub-regions seen in other scenarios—most notably Puketoi ki Tai, Middle Manawatū–Rangitīkei, Tararua, and Whanganui–Manawatū Lakes—where average increases in TX30 approach or exceed 0.5 days per year. Exceptional model realisations may exceed one day per year in these select hotspots, but most models and sub-regions keep the increases below that threshold, and changes are not region-wide. Summer (DJF) remains the only season with a meaningful projected rise in TX30; autumn, winter, and spring changes are negligible or absent, consistent with the physical climatology of the region. Inter-model agreement on the sign and geography of summer increases is moderate to high (spatial $R^2 \approx 0.6$), with the largest local increases strongly focused in low-elevation or interior sub-regions. Higher-elevation and coastal areas continue to see little or no change. While this scenario demonstrates the emergence of potentially more frequent extreme hot days in the coming decades, the absolute magnitude remains low compared to later periods or higher-emissions pathways. The spread between the highest and lowest projected changes is substantial, especially in hotspots, but does not undermine the conclusion that increases are virtually certain for central and eastern lowland sub-regions. The regional signal of warming is clear, with the largest increases still modest compared to historical year-to-year variability.

6.4 SSP5-8.5: Likely modest, patchy summer increases; spatial extent remains limited

The projected changes in the number of very hot days (>30°C) from 1986–2005 to 2021–2040 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 12. The multi-model mean changes

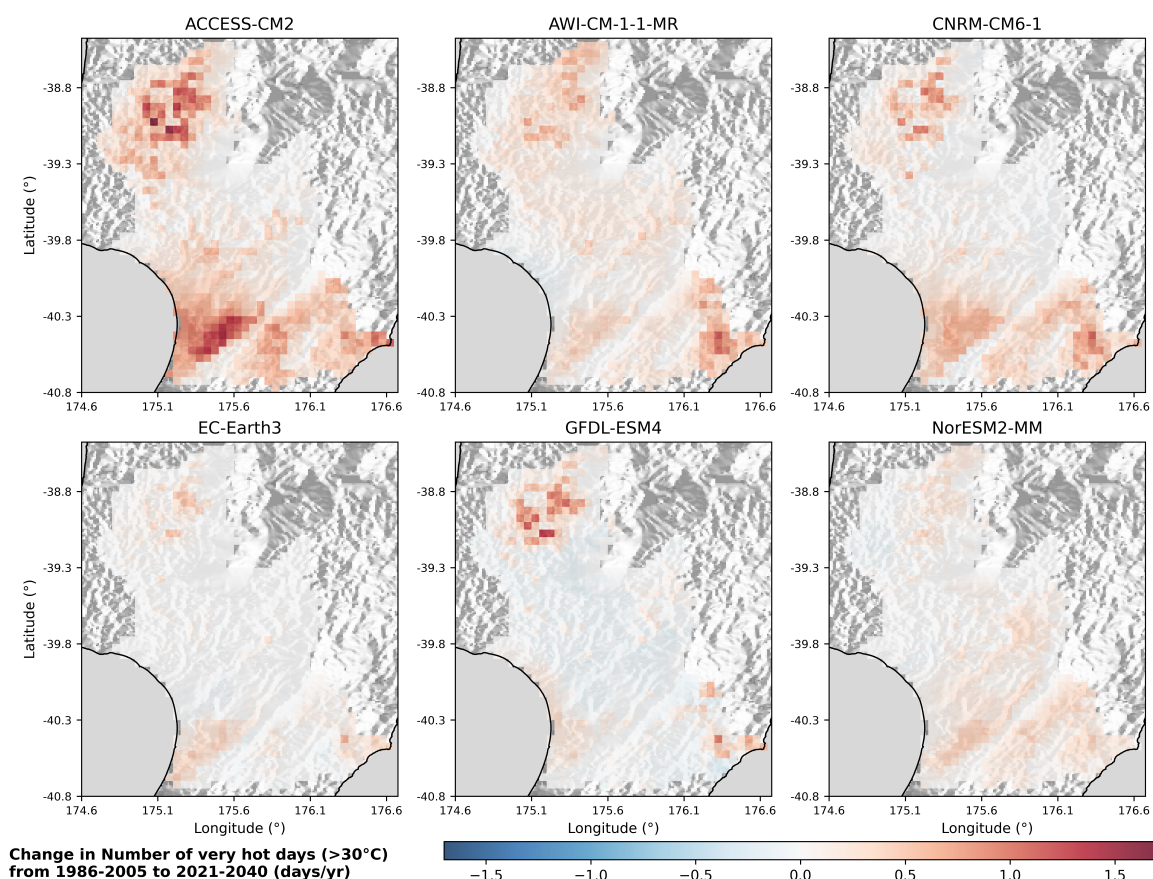


Figure 12: Projected changes in the number of very hot days (>30°C) from 1986–2005 to 2021–2040 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 13.

Under the highest-emissions scenario, SSP5-8.5, the Horizons region is likely to experience a modest but regionally variable increase in annual very hot days (>30°C) for the near-future period 2021–2040. The spatial

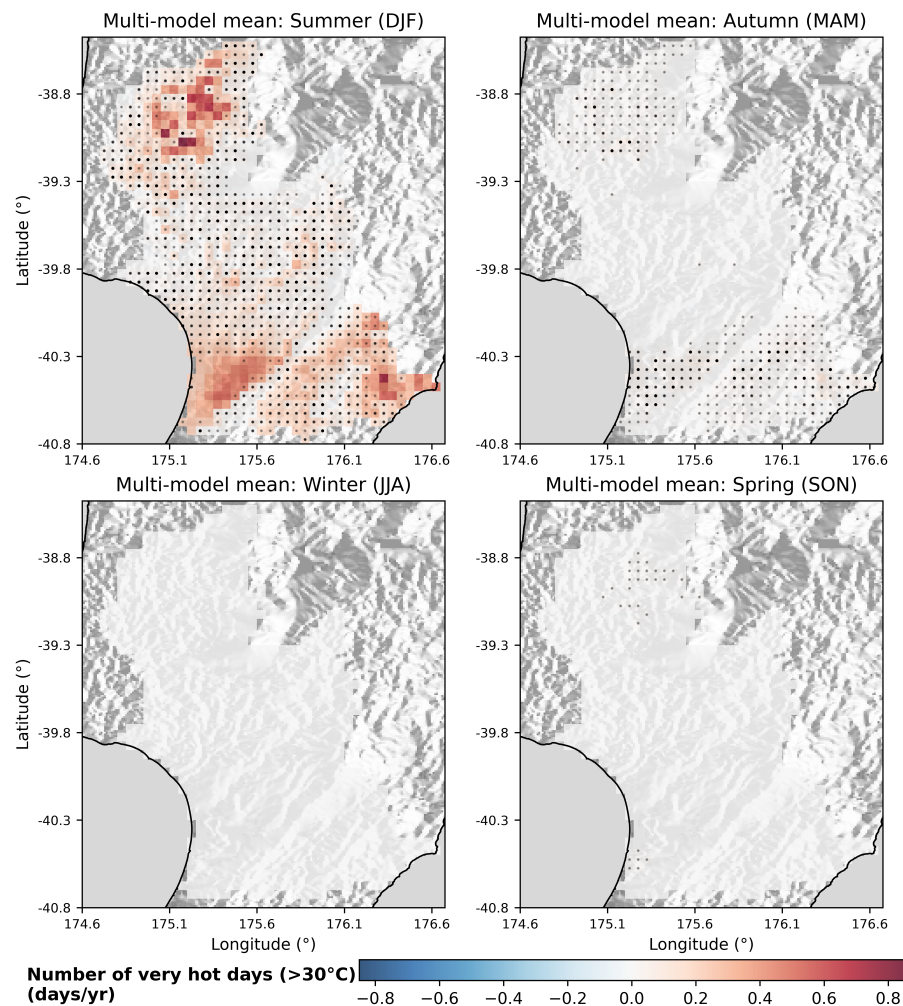


Figure 13: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2021-2040 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



pattern is familiar: the most pronounced increases are again concentrated in interior and eastern lowland sub-regions such as Puketoi ki Tai, Whanganui-Manawatū Lakes, and Middle Manawatū–Rangitīkei. In these areas, the ensemble mean projects increases approaching 0.3–0.4 days per year, with occasional maxima approaching one additional very hot day annually according to outlier models. The absolute numbers remain small, as the baseline occurrence of TX30 days is so low, but the proportional increases are significant. Summer (DJF) is the only season showing substantial change; increases in other seasons are negligible or non-existent, and the pattern of absence for winter and spring persists with almost no model dispersion. Inter-model agreement on regional direction of change is moderate, with highest confidence in the summer and low-elevation spatial focus. Local decreases projected by some models in coastal or highland areas are of low magnitude, and spatial agreement on local detail is moderate to low. The maximum projected increases are somewhat larger than in lower-emissions scenarios, but the region-wide signal still falls within modest bounds for this time horizon. As such, for the 2021–2040 period, even high-emissions futures do not produce frequent very hot days, though the trend to more frequent extremes is clear and foreshadows further increases later in the century.

6.5 Comparison Across Scenarios

Across all four SSP scenarios, the near-future (2021–2040) period is characterised by modest but likely regionally consistent increases in the frequency of very hot days, mainly restricted to summer and lowland/inland sub-regions. The magnitude and spatial coverage of these increases are greater in the high-emissions scenarios, but none project widespread or large absolute changes—most increases stay below one additional day per year, even in hotspots. Model agreement is highest for summer warming, with uncertainties greatest in local details. Importantly, for all SSPs, winter and spring remain virtually unaffected, and local decreases, where present, are small. Therefore, adaptation and risk management responses can be regional and summer-focused, as increases in extreme heat are both moderate in magnitude and strongly seasonal in manifestation.

7 Mid-Century Projections (2041–2060)

By mid-century (2041–2060), all scenarios project a very likely and more pronounced increase in the number of very hot days (>30°C) in the Horizons region, though the spatial and seasonal structure of the change remains consistent with near-term findings. The most significant increases continue to occur in the summer (DJF) and are most pronounced in the region’s low-elevation, inland sub-regions—such as Puketoi ki Tai, NorthernZone-Taumarunui, Tararua, and Middle Manawatū–Rangitīkei. While the baseline historical occurrence of very hot days is extremely rare, ensemble means now indicate mid-century regional averages approaching or just over one additional very hot day per year in these hotspots under higher-emissions scenarios (SSP3-7.0, SSP5-8.5) and 0.5–0.7 days per year in lower or intermediate scenarios (SSP1-2.6, SSP2-4.5). The local maxima from individual models suggest that some areas could see grid-scale increases of up to 7–8 days per year, though these outcomes remain spatially limited and model-dependent. Winter and spring continue to register no or negligible change; the projected increases are overwhelmingly concentrated in summer, with minor and isolated expansions into autumn in a few sub-regions but without robust regional support. Inter-model agreement on the regional pattern of summer increases is moderate to high (mean spatial R^2 between 0.5 and 0.7 across scenarios), with the greatest divergence among models relating to local magnitude rather than the sign of change or broad spatial disposition. While some areas remain largely unaffected—especially higher elevation or coastal zones—the signal of increased summer heat extremes is highly robust for the region overall, with regional ensemble percentiles supporting extremely likely increases in all but the most elevated sub-regions. These results highlight a transition towards a more distinct, though still not dominant, role for extreme summer heat events in the Horizons region’s climate, calling for adaptive planning in regions projected to experience the greatest change.



7.1 SSP1-2.6: Very likely, moderate summer increases; spatially focused, low magnitude

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 14. The multi-model mean changes

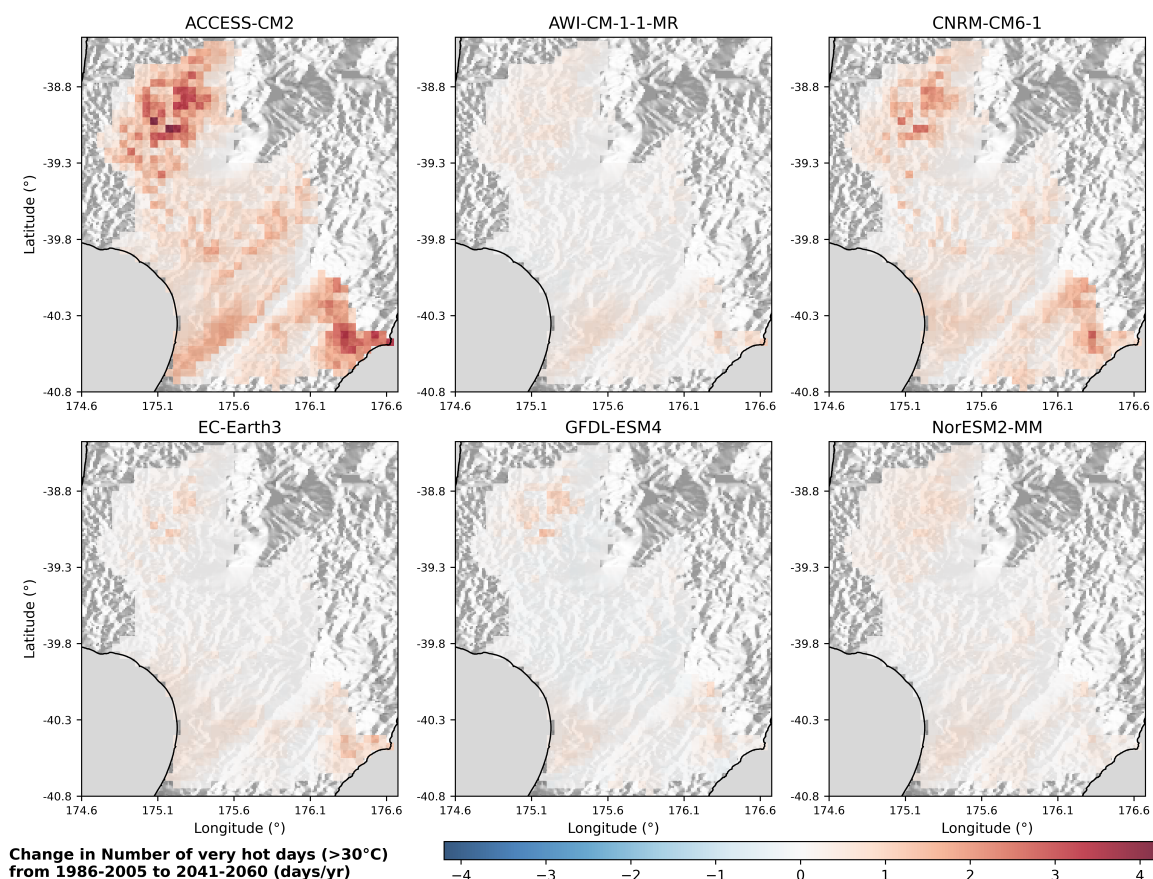


Figure 14: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 15.

For SSP1-2.6, mid-century projections (2041–2060) show a very likely, though still modest, increase in the frequency of very hot days (>30°C) throughout the Horizons region, especially in the summer months. The regional mean ensemble change hovers around 0.3–0.7 days per year in the most-affected sub-regions, such as Puketoi ki Tai and NorthernZone-Taumarunui, with occasional maxima exceeding one additional very hot day annually in hotspots. Areas with moderate warming—Middle Manawatū–Rangitikei, Tararua, Whanganui-Manawatū Lakes—see increases half as great, while elevated or coastal areas like Volcanic Plateau and Upper Rangitikei experience much smaller changes. The seasonal structure remains: increases are almost entirely confined to summer, with only isolated and minor expansions into autumn and virtually zero change in winter or spring. Inter-model agreement is strong on the direction of summer changes, but moderate regarding the local magnitude and distribution (spatial $R^2 \approx 0.53$), underscoring a robust regional signal but uncertainties at the local level. Across the ensemble, no area is projected to see a substantial reduction in very hot days; even minimum projections remain near zero, or only trivially negative, outside a handful of marginal coastal or elevated locations. All sub-regions, even those with low absolute values, see an increase in TX30, indicating a very high likelihood that warming will continue to erode historical climate rarity of such extremes. Model spread increases with magnitude of change, but ensemble percentiles confirm very likely regional increases—now reaching magnitudes that could influence land management and public health, especially in the summer months.

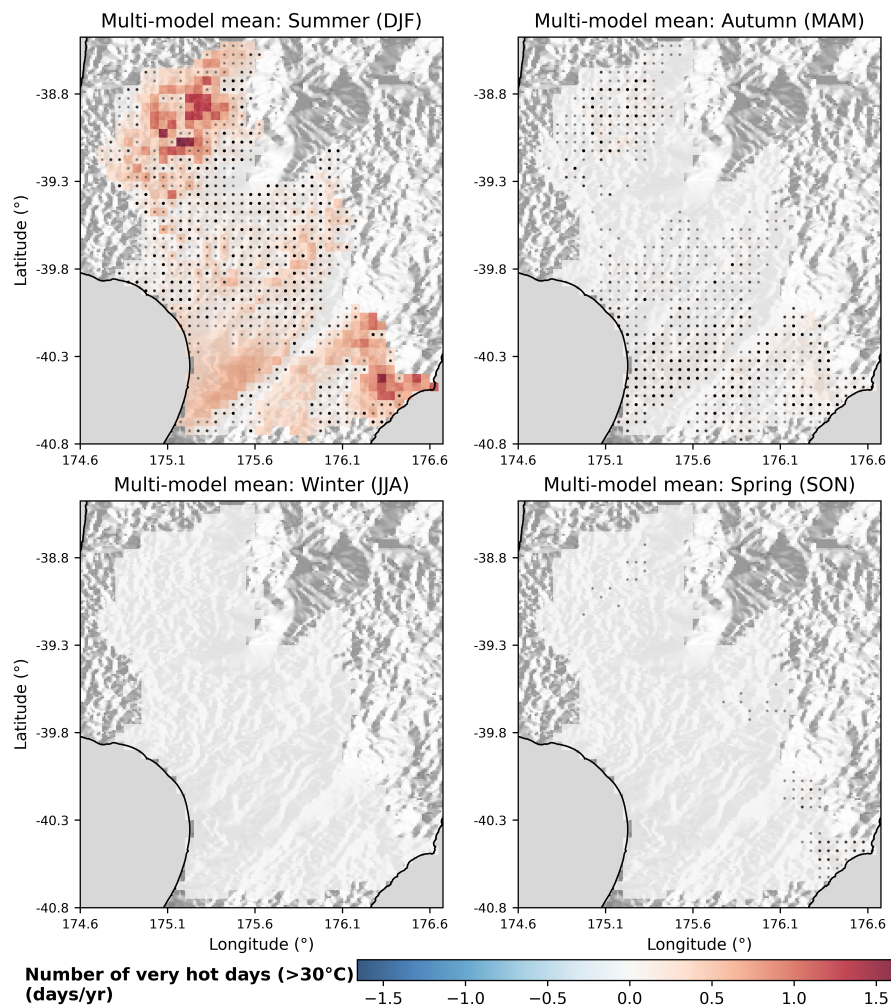


Figure 15: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).

7.2 SSP2-4.5: Very likely moderate, summer increases; widespread, but spatially variable

The projected changes in the number of very hot days ($>30^{\circ}\text{C}$) from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 16. The multi-model mean changes

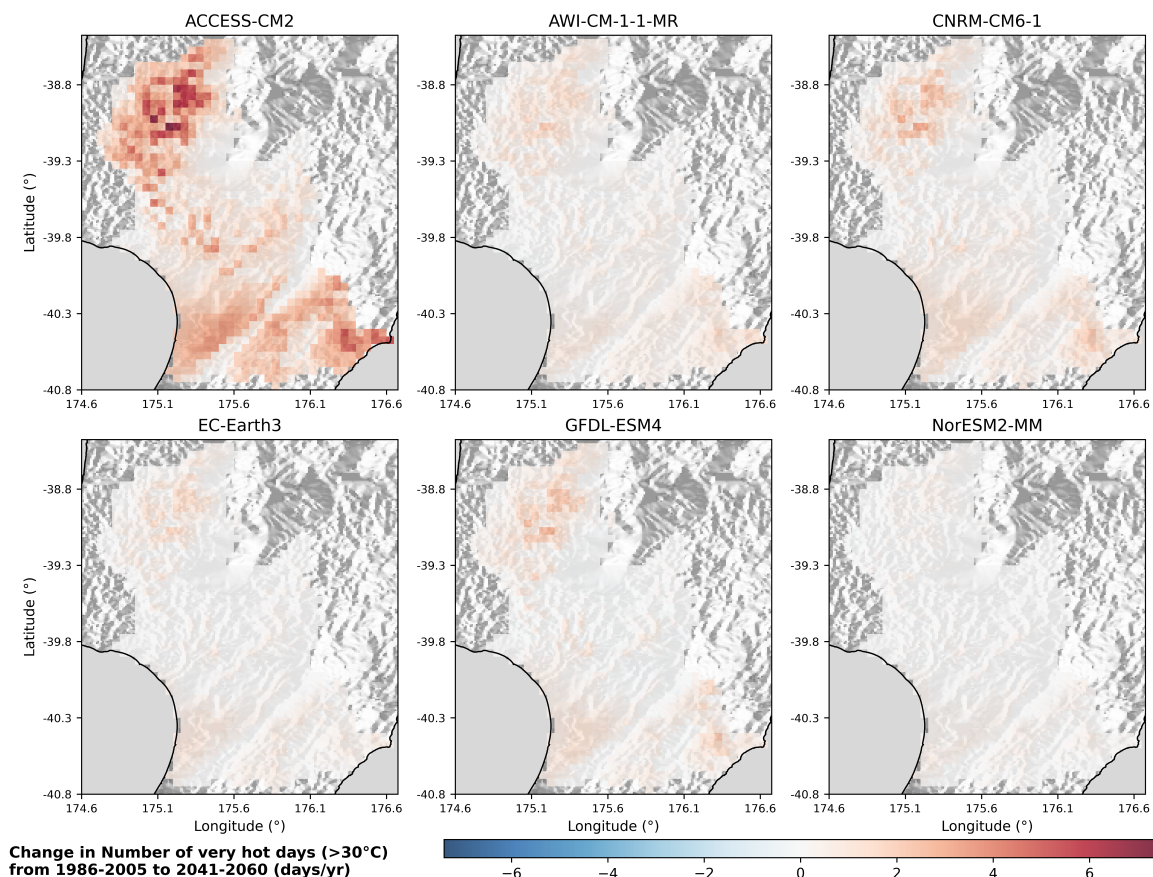


Figure 16: Projected changes in the number of very hot days ($>30^{\circ}\text{C}$) from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

in the number of very hot days ($>30^{\circ}\text{C}$), for each season, are shown in Figure 17.

For SSP2-4.5, a moderate-emissions scenario, mid-century (2041–2060) projections show a very likely (probability >66%) and more substantial increase in very hot days (>30°C), especially in the summer. Mean increases approach or surpass one additional very hot day per year in the Puketoi ki Tai, NorthernZone-Taumarunui, and Whanganui-Manawatū Lakes sub-regions, while many other areas see mean increases of 0.5 days or more. Maximum grid-scale increases in hotspot models reach up to 7 days per year in some locations, but typical values are lower. The magnitude of increases is substantial and spatially extensive for summer, with strong agreement between models on the broad regional pattern but lingering uncertainties in local maxima/minima (spatial $R^2 \approx 0.69$). Autumn sees minor, patchy increases in a handful of sub-regions, but for most of the region and for winter and spring, no meaningful increase is projected. The lower bound of ensemble projections is positive in most cases, suggesting that clustered sub-regions—even those with low historical TX30—will likely experience noticeable increases by mid-century, distinguishing this scenario from the lower-emissions future. No models indicate persistent or widespread reductions in very hot days; negative values are spatially sparse and minor. The projected amplification of extreme summer heat is particularly robust in interior and lowland areas, with ensemble maxima indicating localised risk of 3 or more very hot days per year where the baseline was virtually zero. The results underscore the critical role of emissions trajectory in shaping mid-century heat risk, and the need for spatially nuanced adaptation.

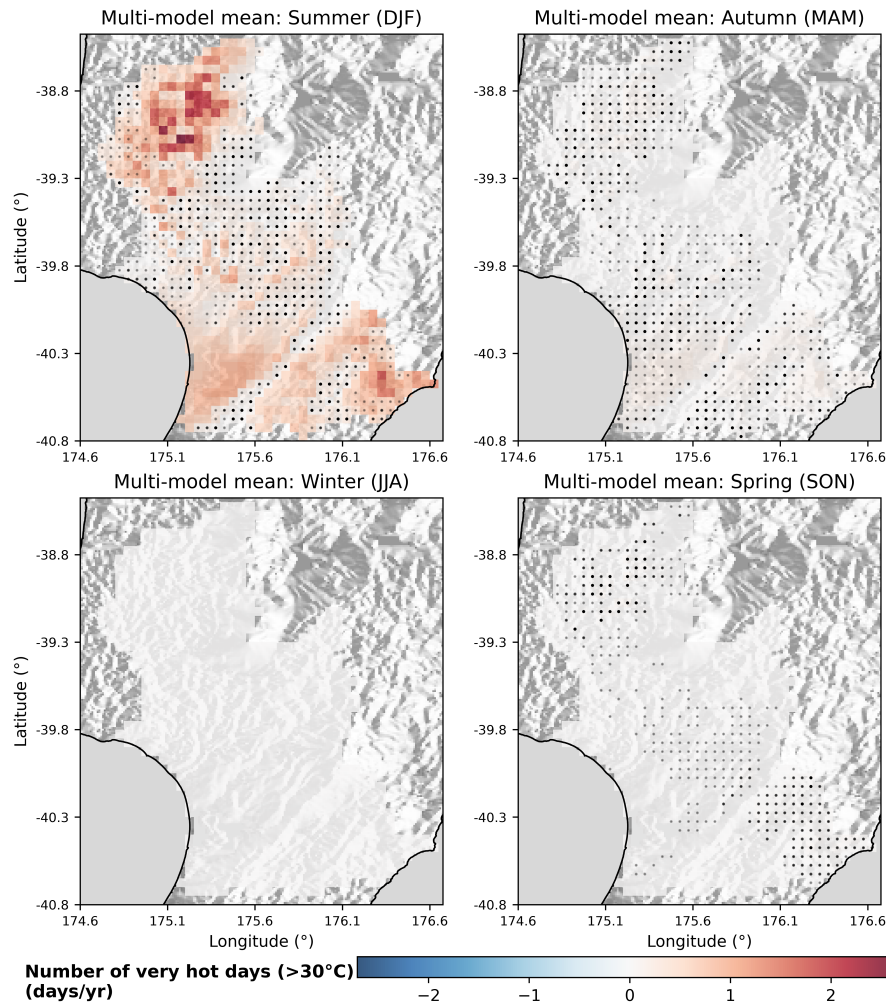


Figure 17: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



7.3 SSP3-7.0: Very likely moderate summer increases; spatially widespread, higher maxima

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP3-7.0 scenario, as simulated by the six different models, are shown in Figure 18. The multi-model mean changes

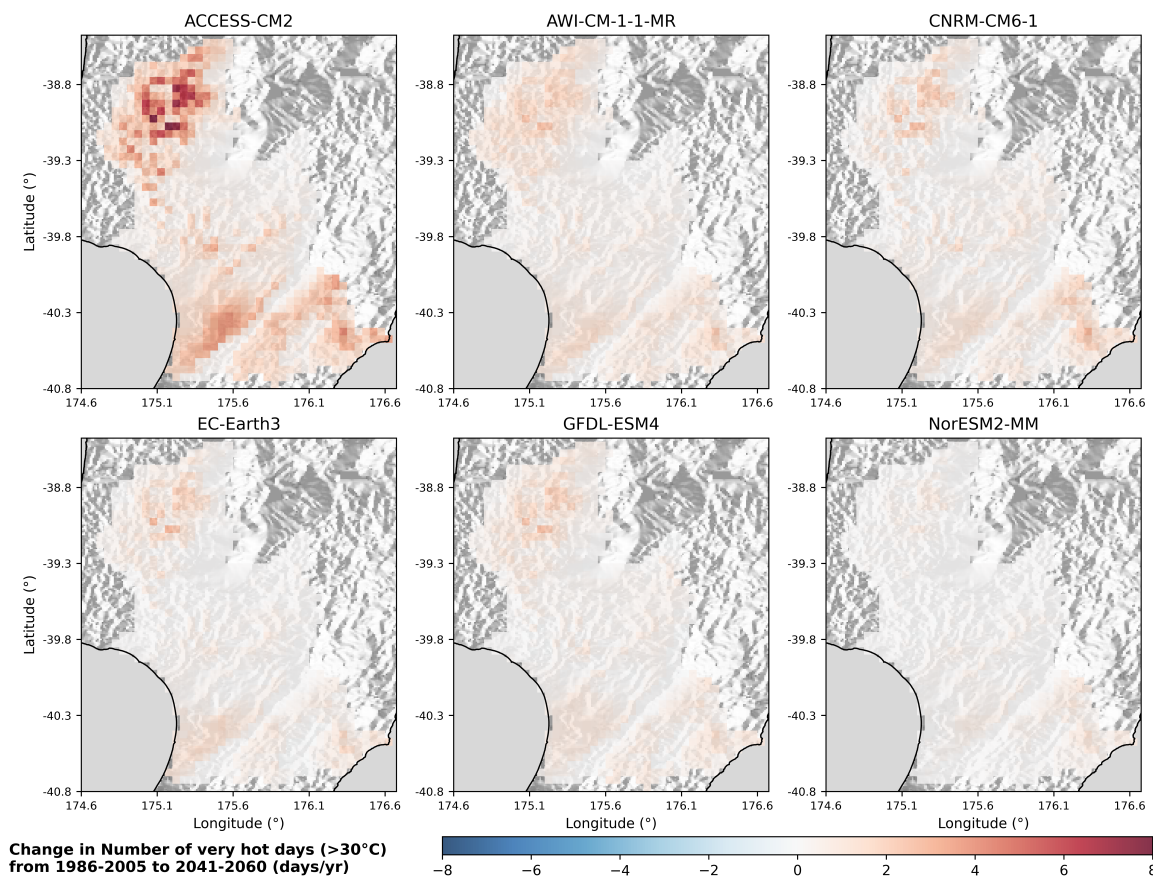


Figure 18: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP3-7.0 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 19.

Projections under SSP3-7.0, a high global challenges scenario, indicate a widespread and robust increase in the annual count of very hot days by 2041–2060. Regionally, mean annual increases reach or exceed one day per year in the warmest lowland areas—such as Puketoi ki Tai, NorthernZone-Taumarunui, and Middle Manawatū–Rangitīkei—and approach or exceed 0.5 days in many other sub-regions. Exceptional model realisations yield grid-point maxima of up to 8 days per year in the most exposed locations, although most model projections do not reach these extremes. The signature of change is overwhelmingly seasonal, with summer (DJF) accounting for virtually all increased TX30 days; autumn sees only scattered, minor increases, while winter and spring remain unchanged. Model agreement is very high on the spatial pattern, with mean spatial R^2 of about 0.69, and virtually all models indicating an increase everywhere, though uncertainty persists for the local magnitude, especially in the hottest regions. Spatial standard deviation and percentile range both increase in hotspots, marking areas of heightened uncertainty and sensitivity to model choice. No sub-region stands out as an exception to the warming trend, but Volcanic Plateau and Upper Rangitīkei are persistently less affected. These results establish a high-confidence, scenario-dependent escalation of extreme summer heat—likely to be climatically and ecologically consequential for the region. The findings support robust summer-focused adaptation policies and planning.

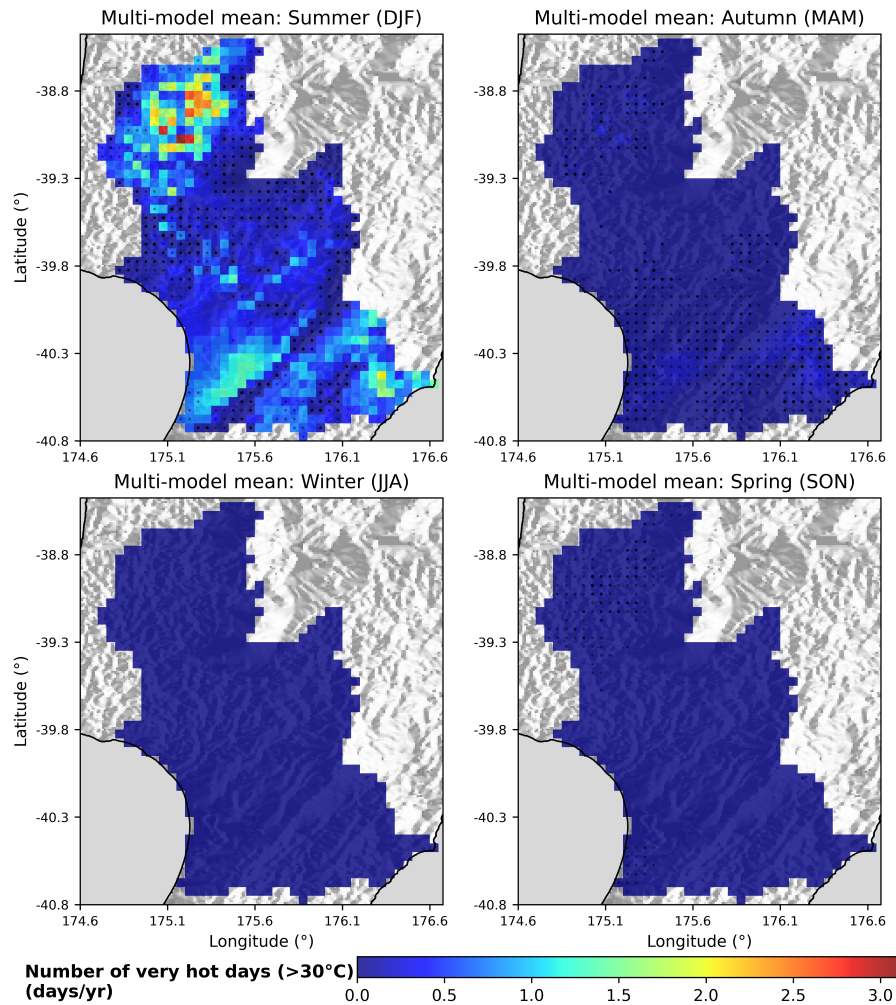


Figure 19: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



7.4 SSP5-8.5: Extremely likely moderate summer increases; near-universal, moderate magnitude

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 20. The multi-model mean changes

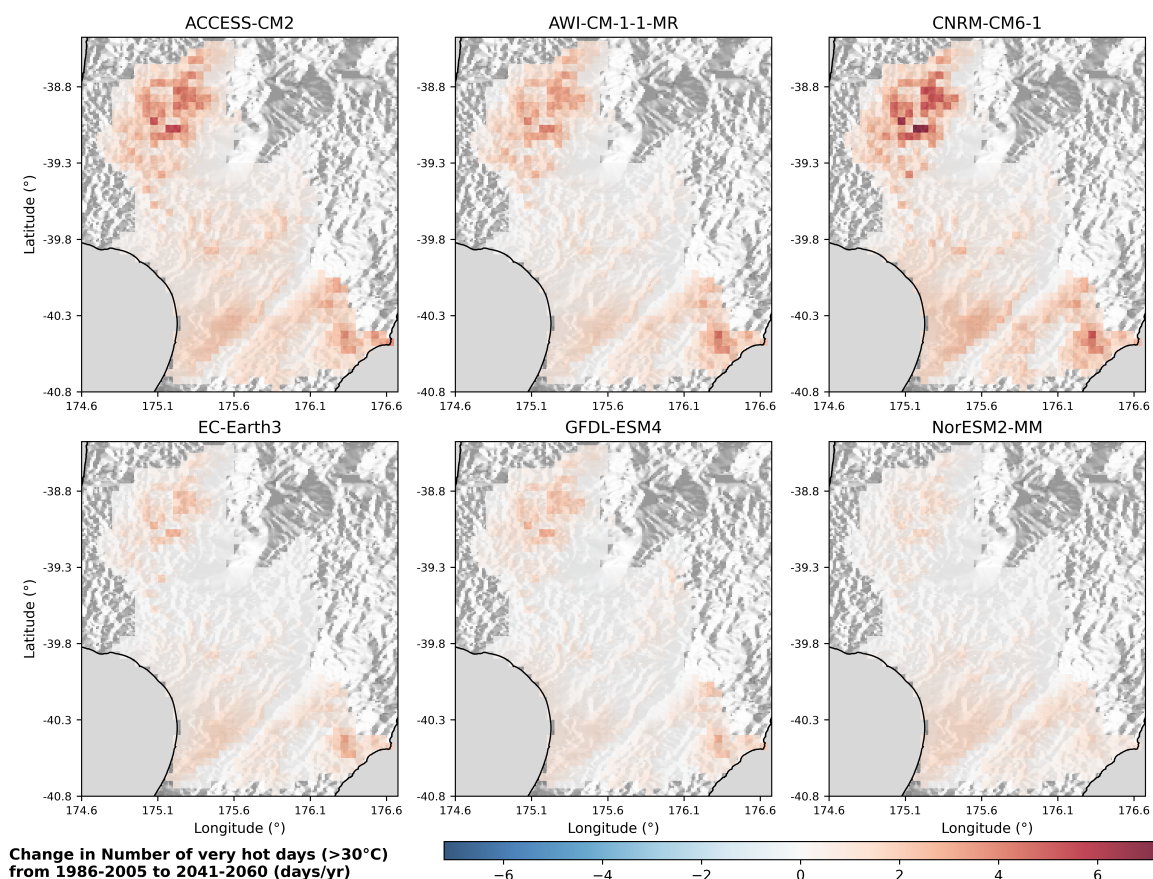


Figure 20: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 21.

SSP5-8.5, representing high emissions and rapid economic development, projects a strong, widespread, and regionally robust increase in very hot days for the Horizons region by 2041–2060. Mean increases in the hottest sub-regions (Puketoi ki Tai, NorthernZone-Taumarunui, Middle Manawatū–Rangitīkei) approach or surpass 1.5 days per year, with local exceedances up to 4 days in ensemble maxima. Almost every sub-region, including those with modest historical TX30 values, shows statistically significant increases—often by an order of magnitude compared to baseline. Seasonal disaggregation confirms these changes are almost exclusively summer (DJF) focussed, with slight and spatially inconsistent increases in autumn and no change in winter or spring. Spatial agreement among models is high, with mean spatial $R^2 \approx 0.74$, and the entire region registers a persistent and positive summer signal; even the coldest or most coastal sub-regions experience modest absolute gains. Ensemble percentiles suggest that all but the historically coolest sub-regions (Volcanic Plateau, Coastal Whanganui) are virtually certain to experience annual mean increases of at least 0.5 days, with maxima up to 3 or more per year in the typical summer. No area is projected to see reductions in TX30 by mid-century. Spread is moderate between models, but the signal is sufficiently robust for high-confidence planning. In summary, under continued high emissions, the Horizons region faces the prospect of a future where summer very hot days become a non-negligible climate feature, demanding attention for adaptation and resilience planning.

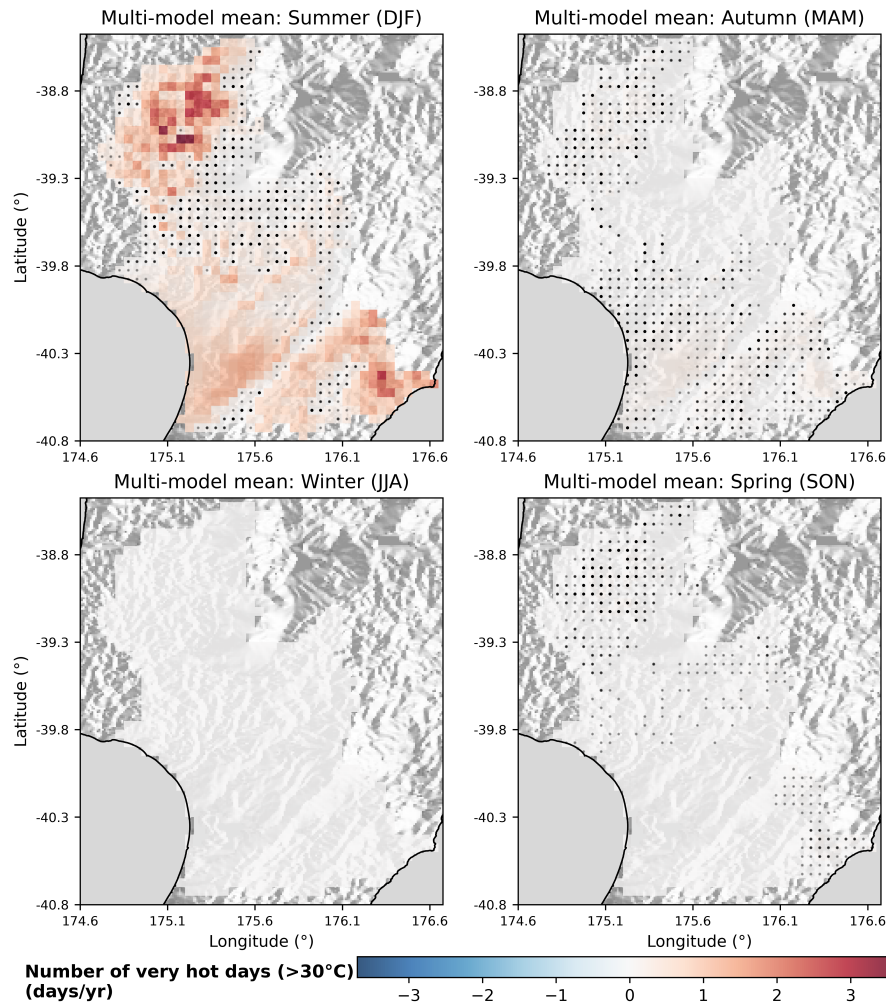


Figure 21: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2041-2060 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



7.5 Comparison Across Scenarios

By mid-century, all scenarios show very likely and spatially widespread increases in very hot summer days, with higher-emissions pathways yielding greater absolute changes. The pattern remains highly seasonal, with increases almost entirely confined to summer (DJF). The magnitude of change becomes larger and more spatially extensive in SSP3-7.0 and SSP5-8.5, with mean increases now approaching or surpassing one day per year in hotspots and notable increases even in previously unaffected sub-regions. Inter-model agreement is high for the direction and broad spatial structure of change, but uncertainties persist at the local scale and in modelled maxima. Across scenarios, winter and spring remain virtually unaffected by extreme heat, and all sub-regions, regardless of scenario, see more very hot days—though with pronounced spatial contrasts. These results provide robust motivation for focused adaptation in the most affected sub-regions and support scenario-based planning as emission pathway substantially shapes mid-century outcomes.

8 Late-Century Projections (2080–2090)

By the end of the century (2080–2099), all scenarios project a very likely, widespread, and, for higher-emissions pathways, dramatic increase in the annual number of very hot days (>30°C) across the Horizons region. The magnitude, spatial footprint, and societal significance of these changes are scenario-dependent, but even under the low-emissions SSP1-2.6, the mean number of very hot days is projected to increase by about half a day per year or more, with some hotspots (e.g., Puketoi ki Tai, NorthernZone-Taumarunui) exceeding one additional day per year. For intermediate and high emissions scenarios (SSP2-4.5, SSP3-7.0, SSP5-8.5), the regional transformation is even greater: ensemble means in the warmest sub-regions rise to 2–8 days per year, with exceptional model maxima exceeding 15–40 days per year, especially for SSP5-8.5. The increases remain almost exclusively confined to summer (DJF), with minor expansion into spring and autumn under the highest scenarios but no meaningful increase in winter. Inter-model agreement on the spatial pattern is extremely high (mean spatial R^2 commonly above 0.9 for summer). Model spread is substantial, particularly in the absolute maxima, but the sign and configuration of change are robust region-wide. Previously unaffected sub-regions (e.g., Volcanic Plateau, Upper Rangitikei, Coastal Whanganui) now experience substantial increases though the absolute frequency still trails behind interior hotspots. All scenarios now show that very hot days—historically rare—become a regular feature of summer in large parts of the region, with the potential for profound impacts on health, ecosystems, and infrastructure. This underscores the importance of mitigation for limiting change magnitude and adaptation for managing emerging risks.

8.1 SSP1-2.6: Very likely modest, summer increases; focused, low magnitude, widespread

The projected changes in the number of very hot days (>30°C) from 1986–2005 to 2080–2099 under the SSP1-2.6 scenario, as simulated by the six different models, are shown in Figure 22. The multi-model mean changes in the number of very hot days (>30°C), for each season, are shown in Figure 23.

For SSP1-2.6, late-century projections (2080–2099) indicate a very likely, spatially variable but still modest increase in very hot days (>30°C) across the Horizons region. Ensemble means in the warmest sub-regions rise to about 0.6 days per year, with model maxima above one day annually, while colder or elevated areas remain near 0.1–0.3 days per year. The increase remains strongly seasonal, with virtually all the change in summer (DJF); autumn, winter, and spring see only isolated, minor occurrences unlikely to be significant at the regional scale. Inter-model agreement on the spatial pattern is moderate to high (mean $R^2 \approx 0.5$ for summer), though considerable divergence in local maxima and minima persists. No sub-region is projected to see decreasing TX30, and even the coldest or wettest locations register clear increases. The spread between model percentiles is wide—uncertainty in the magnitude of increases grows through time—but the sign of change is robust. The transformation from a rare to a more regular climate feature, though moderate in size, is significant for

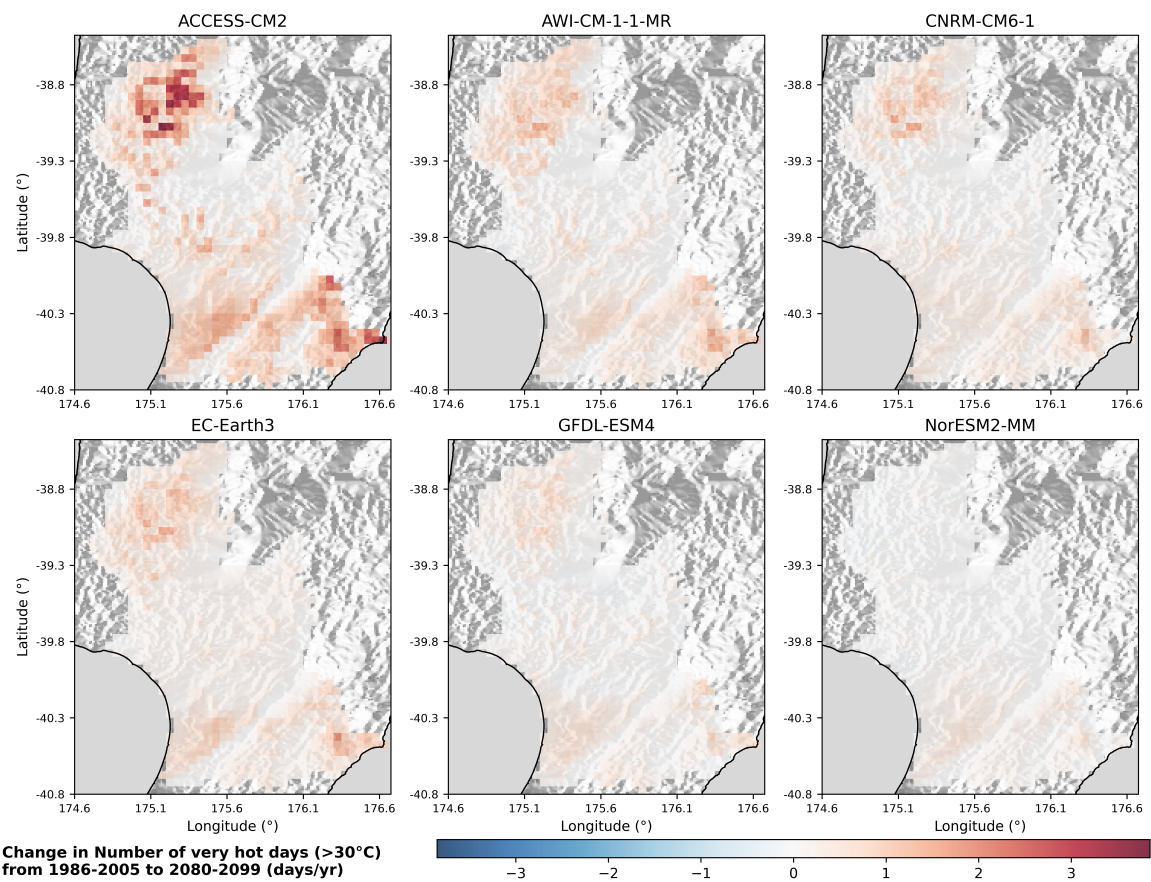


Figure 22: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP1-2.6 scenario. The original of this figure is available [here](#).

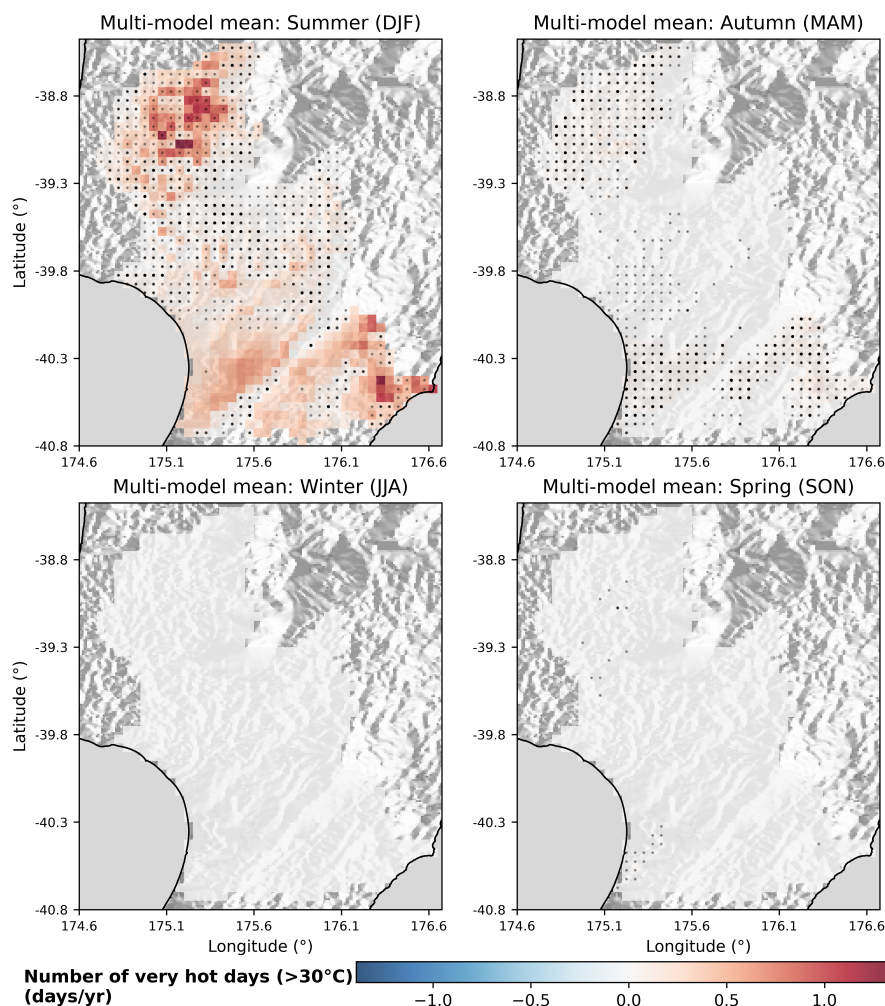


Figure 23: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP1-2.6 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



areas with little historical experience of extremes. For all sub-regions, minimum ensemble projections at worst approach or slightly dip below zero, but the regional summary is one of very likely widespread, if moderate, increases in extreme heat days, necessitating planning even under best-case mitigation futures.

8.2 SSP2-4.5: Extremely likely moderate-to-large, summer increases; robust, spatially widespread

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP2-4.5 scenario, as simulated by the six different models, are shown in Figure 24. The multi-model mean changes

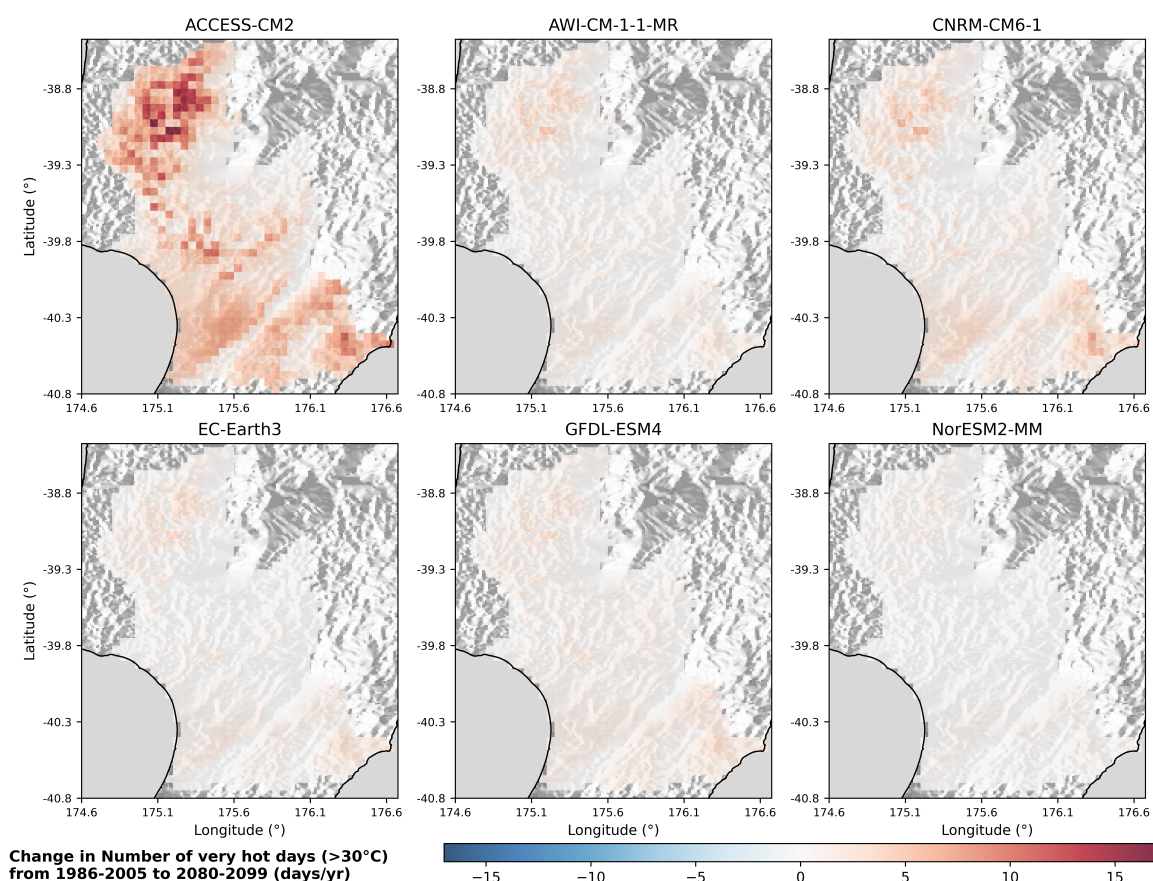


Figure 24: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP2-4.5 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 25.

For SSP2-4.5, intermediate-emissions projections to 2080–2099 show substantial and widespread increases in the frequency of very hot days across the Horizons region, particularly in interior and low-elevation sub-regions. Mean annual increases reach or exceed 2–3 days in hotspots such as Puketoi ki Tai, NorthernZone-Taumarunui, and Middle Manawatū–Rangitikei, with the upper end of ensemble maxima rising to nearly 17 days per year in exceptional cases. All sub-regions, including those currently unaffected, show robust increases: even cooler or higher elevation areas see mean changes around or above 0.4 days per year. The seasonal pattern holds—almost all additional very hot days occur in summer, with minor increases in autumn and occasional trace events in spring for a few sub-regions. Inter-model agreement is extremely strong for the broad spatial pattern (mean $R^2 > 0.7$ for summer). While model spread remains wide in the magnitude, the sign of change is robust everywhere, and no models project reductions or unchanged TX30 at the sub-region scale. Ensemble percentiles confirm it is extremely likely (IPCC language) that all sub-regions will experience a marked increase in summer extremes, with impacts likely to cascade into natural and managed systems. These findings suggest the need for long-term adaptation—especially where historical experience of very hot days has been minimal.

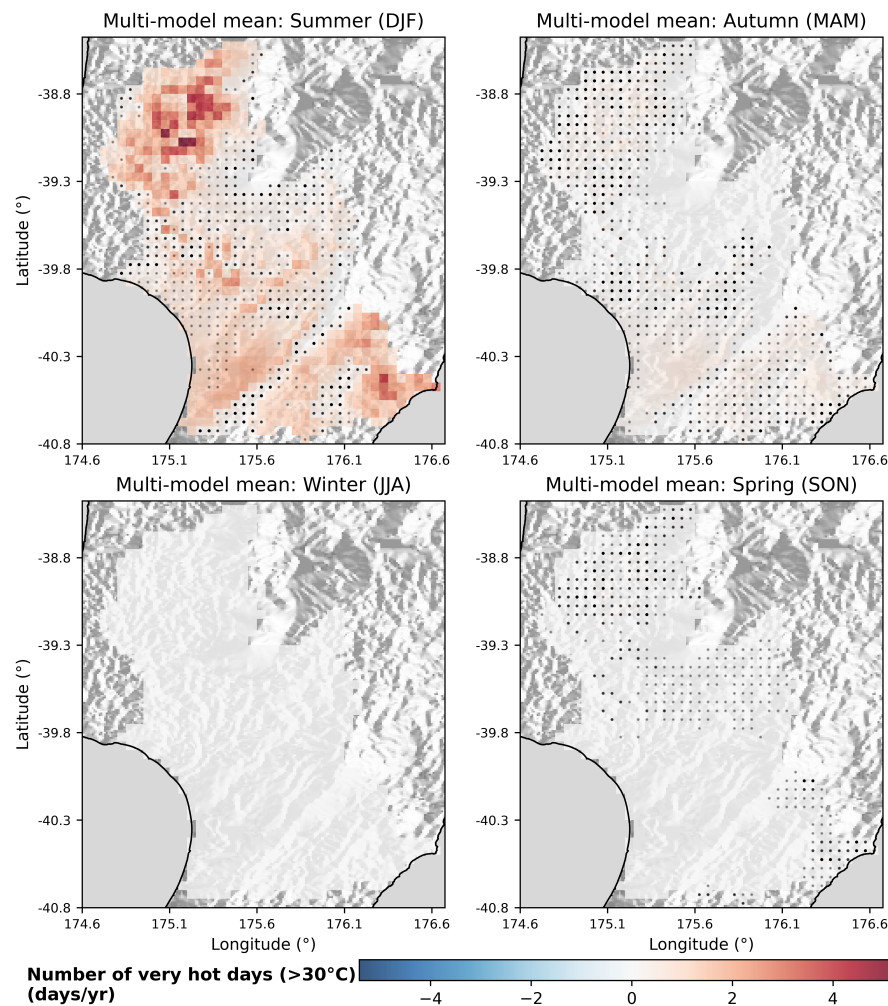


Figure 25: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP2-4.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



8.3 SSP3-7.0: Virtually certain large, summer increases; extensive, high magnitude change

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario, as simulated by the six different models, are shown in Figure 26. The multi-model mean changes

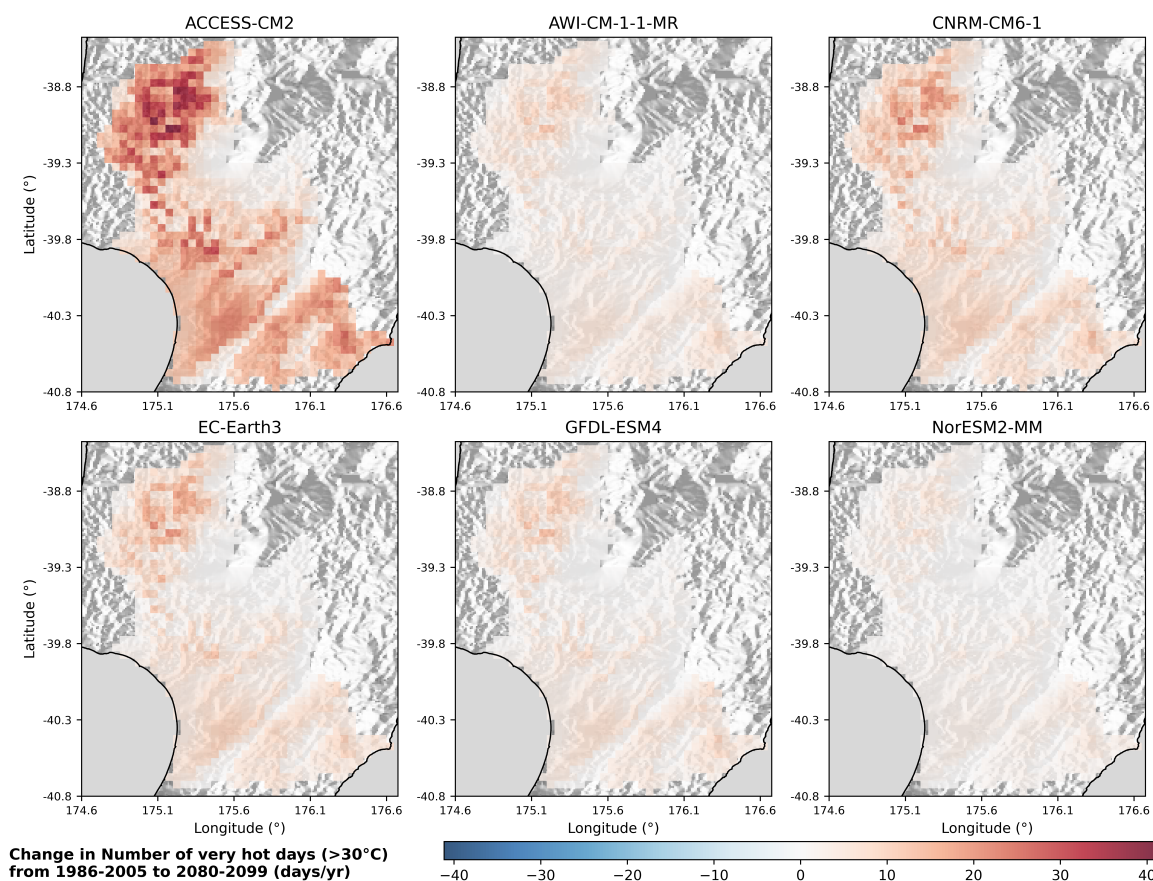


Figure 26: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 27.

SSP3-7.0, a high-emissions pathway with limited global mitigation, yields substantial late-century (2080–2099) increases in the annual number of very hot days across the Horizons region. In the region’s interior and northern lowlands (e.g., NorthernZone-Taumarunui, Puketo i Tai, Middle Manawatū–Rangitīkei), mean annual TX30 counts rise to 8–13 days or greater, with maxima in individual model runs reaching 12–41 days in the most exposed grid cells. Lower elevation and coastal zones (e.g., Volcanic Plateau, Coastal Whanganui) also see large increases, though mean annual rates remain lower (about 1.5–4 days). Seasonality is pronounced: the expansion and intensification of very hot days occurs almost entirely in summer, with minor but increasing autumn and spring occurrences in hotspots and no change in winter. Inter-model agreement on the spatial pattern of change is exceptionally high ($R^2 > 0.9$ for summer), while ensemble spread in the magnitude of change is large—model maxima are often several times ensemble means, indicating high absolute but not relative confidence in local extremes. Model agreement is universal on the direction of change: not a single sub-region shows a non-positive change in the ensemble means or medians. The transformation is striking: from virtually no very hot days in the historical climate to a regular, sometimes prolonged, summertime feature, with more than a week’s worth of very hot days each summer in the most affected areas.

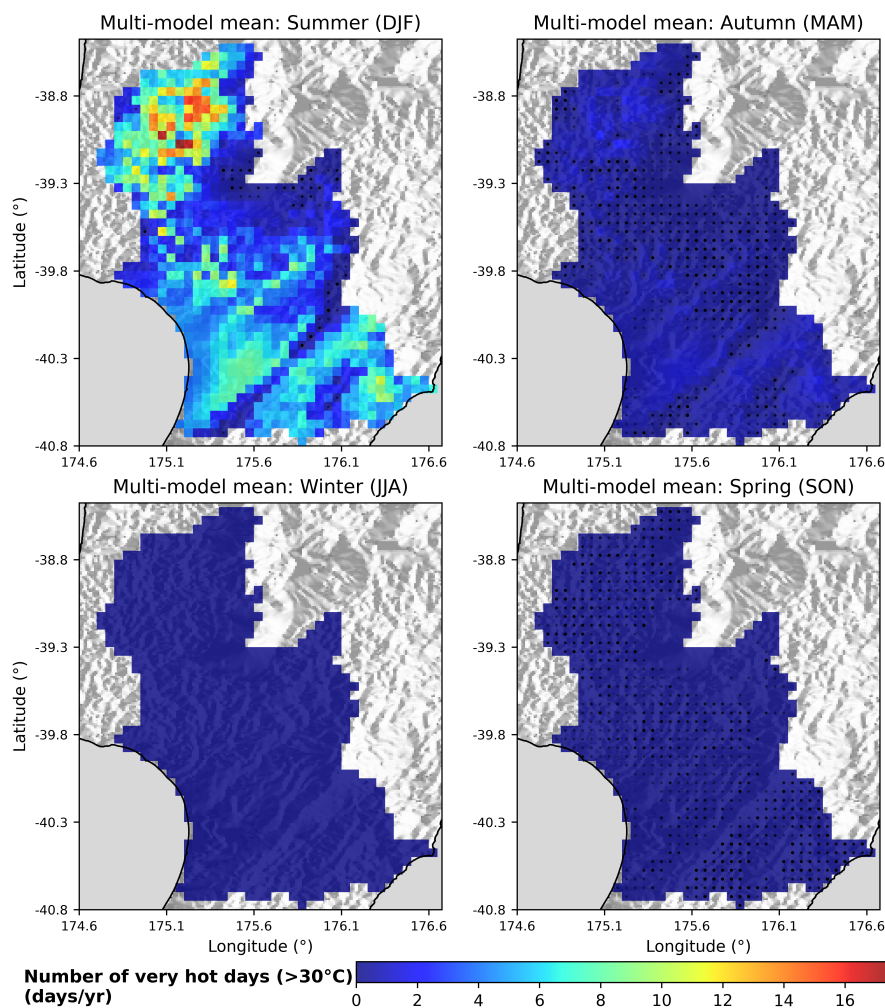


Figure 27: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP3-7.0 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



8.4 SSP5-8.5: Extremely likely large summer increases; pervasive, high-magnitude, spatially robust

The projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario, as simulated by the six different models, are shown in Figure 28. The multi-model mean changes

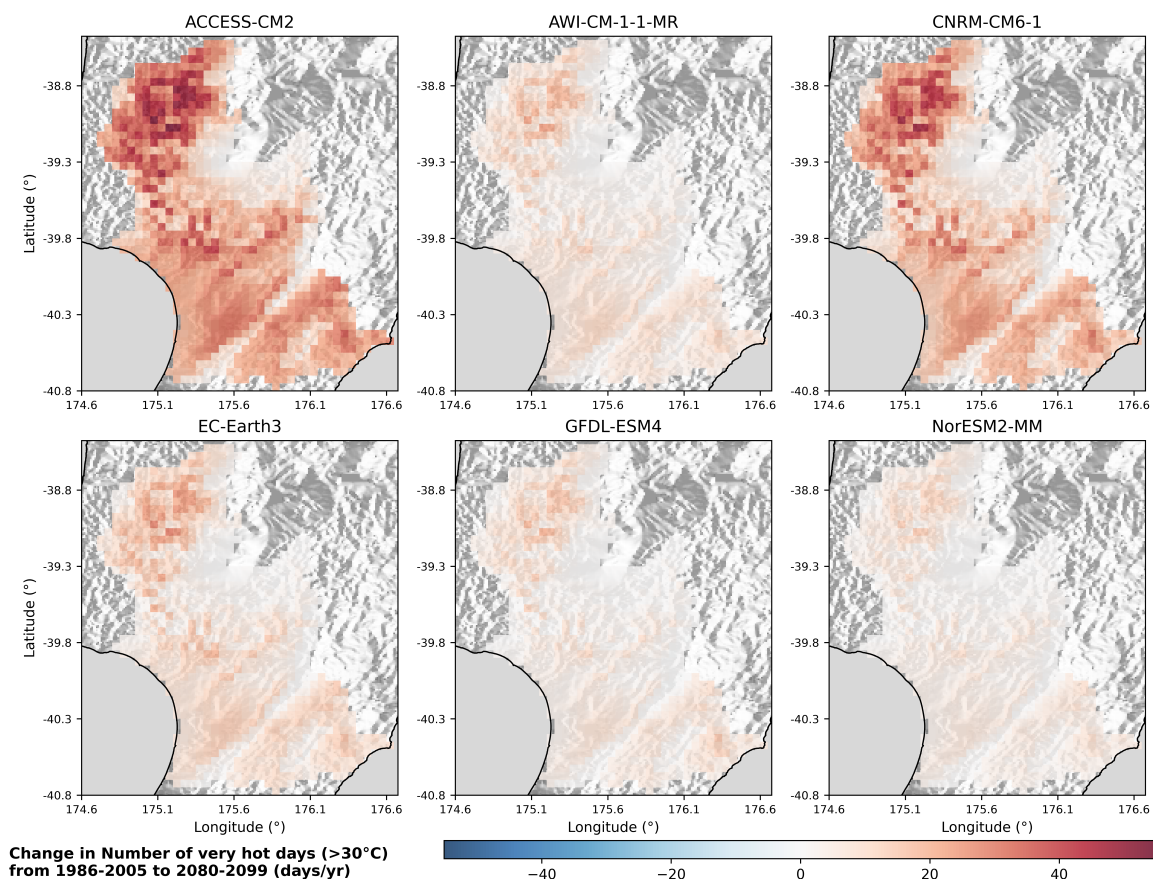


Figure 28: Projected changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario. The original of this figure is available [here](#).

in the number of very hot days (>30°C), for each season, are shown in Figure 29.

Under SSP5-8.5, the highest-emissions scenario, the Horizons region faces an extremely likely, dramatic escalation in the number of very hot days by the end of the 21st century. Mean increases reach or exceed 8–14 days annually in northern and central lowland sub-regions (NorthernZone-Taumarunui, Puketoi ki Tai, Middle Manawatū–Rangitīkei), with ensemble maxima climbing to more than 30–50 days in isolated model runs and grid cells. Even the coolest sub-regions (Volcanic Plateau, Coastal Whanganui, Upper Rangitīkei) are projected to experience average annual increases of 4–5 days. The transformation is not merely relative; it is profound in absolute terms—historically rare events become a persistent summer reality region-wide. The overwhelming proportion of this increase is confined to summer, with some expansion into autumn and very rare spring events; winter remains virtually unaffected. Model agreement on the spatial pattern is very high ($R^2 \approx 0.92$), with uncertainties almost entirely in the absolute magnitude rather than qualitative effects. Ensemble percentiles are universally positive—every sub-region and essentially every model projects more frequent and persistent extreme summer heat. The size of the projected increases, their spatial extent, and model concurrence on the direction and pattern of change leave virtually no doubt about the future emergence of extreme heat events under sustained high emissions, demanding urgent attention for adaptation, resilience, and possibly migration of at-risk communities and infrastructure.

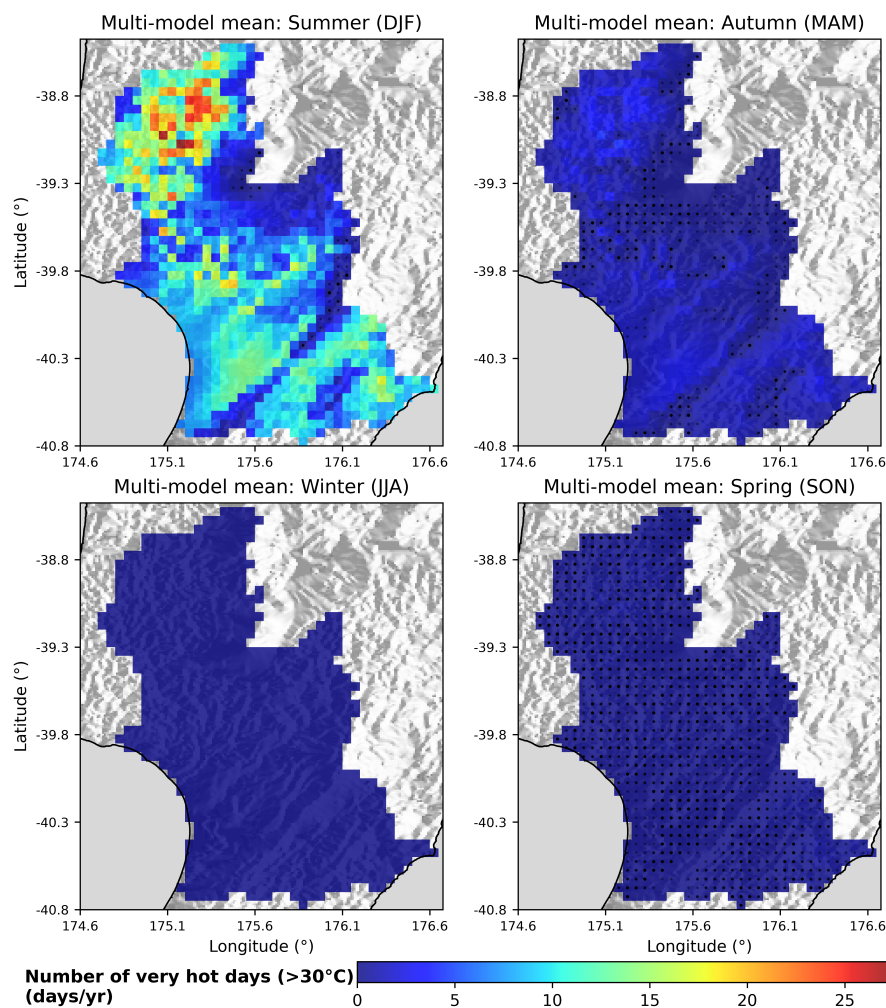


Figure 29: Multi-model mean changes in the number of very hot days (>30°C) from 1986-2005 to 2080-2099 under the SSP5-8.5 scenario for each season. Regions showing no stippling show where the six models are in unanimous agreement as to the *sign* of the change. Light stippling shows where one of the 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](#).



8.5 Comparison Across Scenarios

Across all scenarios, late-century projections show extremely likely, highly seasonal, and regionally widespread increases in very hot days, with magnitude tightly controlled by emissions pathway. The interior, lowland, and northern sub-regions face the largest increases, but even coolest areas experience marked change. In low-emissions scenarios, increases are moderate but still significant for adaptation; in high-emissions scenarios, the transformation is dramatic—potentially exceeding 10–14 additional days per year—posing major risks for health, infrastructure, and ecosystems. Inter-model agreement is near-universal on the spatial pattern and seasonality, with spread mainly in magnitude. By the late 21st century, the Horizons region must plan for the local realities of an historically unprecedented regime of summer extreme heat, even under strong global mitigation efforts.

9 Evolution of Regional Hot-spots

A full breakdown on projected changes in the number of very hot days (>30°C) by region is given in the Appendices. What follows below is a brief overview of those results.

Under all scenarios and timeframes examined, the spatial emergence and intensification of TX30 regional hotspots is a consistent finding in the Horizons region. Historically, very hot days were largely absent outside of small lowland pockets, but as temperatures rise, areas experiencing frequent TX30 events expand and intensify.

Initially (2021–2040), the regional pattern of hotspots is recognisable but only modestly amplified: sub-regions such as Puketoi ki Tai, NorthernZone-Taumarunui, Whanganui-Manawātū Lakes, and Middle Manawātū–Rangitīkei exhibit mean increases of up to 0.4–0.5 days/year, while places like Volcanic Plateau and Coastal Whanganui remain much less affected. The spatial contrast is moderate, though inter-model dispersion means some localities could see their historical number of hot days double or triple—even if the absolute value still rarely exceeds a day per year.

By mid-century (2041–2060), the contrast between sub-regions sharpens further. NorthernZone-Taumarunui, Puketoi ki Tai, and Tararua often show the greatest relative and absolute change, with model maxima sometimes exceeding 2–3 (or more, in higher emissions scenarios) additional days per year. Meanwhile, local hotspots can be highly sensitive to underlying model structure, with some models projecting maxima in excess of five or more additional days in select grid cells. This regional differentiation reflects both amplification of background patterns and geographical controls—interior, low-elevation, and leeward locations consistently lead the increase signal.

Late-century projections (2080–2099) highlight a substantial increase in the frequency, magnitude, and spatial coverage of very hot days under high emissions. For SSP5-8.5, northern sub-regions such as NorthernZone-Taumarunui and Puketoi ki Tai are projected to see mean increases exceeding a fortnight to nearly a month (10–21+ days/year) across models, while the upper edge of model projections in hotspots can surpass 30–50 days/year. Even under low emissions, these locations stand out as regional leaders, with the greatest absolute increases seen in the same already-warm areas. Model agreement remains strongest on the identity of hotspots, less so on absolute maxima.

Inland, low-elevation, and more continental parts of the region emerge repeatedly as the hotspots of TX30 intensification. Elevated and coastal locales, such as Volcanic Plateau and Coastal Whanganui, continue to have smaller absolute increases, although, in relative terms, all regions undergo dramatic percentage increases compared to the baseline. This points to a future where unprecedented extremes become increasingly regular in a limited but expanding subset of the region.

Model analysis further reveals that inter-model spread is systematically higher in hotspots—uncertainty over



exact spatial maxima grows, but confidence in the ranking and location of the most affected sub-regions is very high. For adaptation planning, this means priority should be given to the north and inland (especially Puketoi ki Tai, NorthernZone-Taumarunui, Middle Manawatū–Rangitīkei, and Tararua), as these will bear the brunt of extreme heat increases, with the largest adaptation needs for agriculture, health, and emergency services likely to arise there. In summary, hotspots are already identifiable in the baseline, but will intensify markedly through the century, with a geography that is robust to scenario and model uncertainty.

10 Understanding Projection Uncertainty

10.1 Why uncertainty matters

Uncertainty in climate projections is intrinsic and matters greatly for the number of very hot days (TX30) in the Horizons region. Projections are not deterministic forecasts but express plausible future climates given a range of emissions pathways, model structures, and natural variability. For TX30—where projected increases are typically modest in the near-term but could become substantial by late century—uncertainty analysis guides the clarity and reliability of decision-making, especially around public health, infrastructure, and land management.

There are two main forms of uncertainty: the magnitude of the mean increase, which is important for anticipating general trends region-wide, and the spread of possible outcomes at local or event scales—crucial for preparing for rare but high-impact extremes. In the TX30 context, local maxima projected by one or more models, while not the regional mean, signal ‘tail-risk’—potential for years or locations to experience far more extreme events than the mean alone would suggest. Conversely, minimum projections may highlight resilience or low vulnerability areas, but are sensitive to small ensemble size and outlier effects. Quantifying and interpreting both sources of uncertainty, as well as the model-based confidence in projection spread, is thus integral for robust risk assessment and adaptive planning, especially under a changing climate where the rare today may become common tomorrow.

10.2 Interpreting Ensemble Spread

The use of a six-model ensemble enables an assessment of both the mean projected change and the ensemble spread in TX30. Across all periods and scenarios, where models agree closely on the spatial extent and direction of change, confidence in projections is high—this is apparent in the seasonal structure and the regional hotspots. Where model spread is large, either due to differing climate sensitivities or varying realisations of weather extremes, projections must be interpreted more cautiously. For example, in most seasons and especially for annual means, the multi-model mean and median are closely aligned, and spatial R^2 values in hotspots can exceed 0.7–0.9, indicating robust agreement. However, at local scales (individual grid cells or high-variability sub-regions), spread can be significant, and the standard deviation or range of model outcomes (min-max, P5–P95) widens—reflecting growing uncertainty for extreme or rare outcomes.

The ensemble is particularly robust at identifying where TX30 will increase, and in which seasons, but is less effective at pinpointing the largest or rarest local increases, especially given that only a small number of models are available to sample the tails of the underlying statistical distribution. Nonetheless, consistent ensemble agreement on the sign and seasonality of change means that while absolute values and spatial maxima may be uncertain, the main narrative—more very hot days, especially in summer and in hotspots—holds with very high confidence.



10.3 Minimum, Maximum and Percentile Fields

Analysis of minimum, maximum, and percentile fields reveals a systematic asymmetry in uncertainty quantification for TX30. The maximum projection across all models aligns extremely well with the P95 field—the 95th percentile of projected change—across scenarios and periods, confirmed by regressions with R^2 often at or above 0.97 and slopes near unity. In other words, the upper bound of modelled outcomes can be reliably taken as a near-worst-case plausible increase in TX30 for a given location.

In contrast, the minimum model field—and its statistical alignment with the P5 (5th percentile)—is much less robust. Slopes are consistently below unity, R^2 values typically well below those for the maximum/P95 comparison, and systematic biases are apparent—often, the minimum value is more extreme (lower) than the 5th percentile, indicating a tendency to underestimate plausible lower-bound outcomes.

The practical implication is that the ensemble's maximum and P95 provide a valid upper uncertainty bound for planning, while the minimum substantially under-represents plausible minimum outcomes due to the small ensemble size and model dependence. For risk communication and planning, percentile fields (particularly P95) should be prioritised over simple minimum/maximum statistics, especially when examining sub-regional exposures or absolute upper-and-lower-bound projections. Where high confidence is required, the use of percentiles derived from statistical frameworks or larger ensembles is recommended.

11 Equilibrium Climate Sensitivity and Number of very hot days (>30°C) Change

11.1 Understanding ECS

Equilibrium Climate Sensitivity (ECS) quantifies how much long-term global warming results from a doubling of CO₂ and is a key driver of model-to-model spread in TX30 projections. Models with higher ECS simulate greater regional warming under the same emissions pathway, which in turn translates to larger frequency increases of extreme heat (TX30) as the upper tail of the temperature distribution more routinely crosses the 30°C threshold.

For the Horizons region, analysis shows that differences in projected TX30 increases are partially explained by ECS: models with higher sensitivity drive the largest projected increases, especially in hotspot sub-regions and under higher emissions scenarios. Nevertheless, ECS does not fully account for all model spread. Local patterns depend also on regional climate dynamics, topography, the fidelity of land-atmosphere interactions, and the representation of synoptic weather extremes. Thus, while ECS is a useful diagnostic for the upper bound of warming signal—especially where ensemble maxima/P95 and ECS correlate closely—it cannot explain all geographical or seasonal discrepancies.

In sum, ECS highlights the physical plausibility of large TX30 increases in higher-sensitivity models but is only one of several contributors to ensemble spread. Where TX30 changes exhibit a strong ECS relationship, mitigation of GHG emissions becomes particularly effective at constraining regional extremes.

12 Sources of Uncertainty

12.1 Emissions Uncertainty

Emissions uncertainty, reflecting unpredictability about future economic, technological, and societal pathways, becomes the dominant factor in TX30 projections by late century. While all scenarios show TX30 increases, the magnitude diverges starkly: by 2080–2099, SSP1-2.6 yields modest, localised increases in TX30, while SSP5-8.5 drives widespread increases, often 5–10 times greater in hotspots. This divergence emerges especially



after 2040 and is directly traceable to differences in cumulative greenhouse gas concentrations and resultant regional warming. For adaptation, this uncertainty underscores the importance of mitigation: the scale of adaptation required is closely linked to the global emissions trajectory.

12.2 Climate Model Uncertainty

Climate model uncertainty arises from differences in the physical representation of climate processes among models—including variation in equilibrium climate sensitivity, simulation of large-scale atmospheric dynamics, land-surface processes, and the reproduction of local topography and coastline. This drives spread in TX30 projections, especially for the spatial placement and magnitude of local maxima. While agreement on the direction and broad spatial pattern is high for TX30 (particularly under strong warming), finer detail remains subject to inter-model spread, and outlier models can substantially influence maximum/minimum statistics. Model uncertainty is more significant in the near-term and for localised projections but is gradually overwhelmed by emissions-driven signal by late century.

12.3 Natural Climate Variability

Natural climate variability—arising from modes such as ENSO, SAM, and unforced internal atmospheric and oceanic variations—remains a material source of uncertainty, particularly in the near-term (2021–2040) and for threshold-based extremes like TX30. At these time scales, large interannual and decadal swings can mask or amplify underlying trends, influencing year-to-year counts of very hot days and leading to model divergence, especially where mean increases are subtle. By late century, the externally forced signal dominates in most scenarios, but variability remains significant for adaptation at decadal or sub-decadal planning horizons.

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

Assessment of changes in the annual number of very hot days (TX30) in the Horizons region can be made with varying levels of confidence, in line with IPCC protocols:

- It is virtually certain (>99% probability) that very hot days have been rare in the baseline climate, typically far less than one day per year and virtually absent in non-summer seasons.
- It is extremely likely (>95% probability) that TX30 will increase regionally through the 21st century under all emissions scenarios, with increases concentrated in summer and in identified inland/northern hotspots.
- By late century, the magnitude and spatial degree of increase in TX30 depends on emissions pathway; there is very high confidence that high emissions (SSP5-8.5) will yield the largest and most widespread



increases, while under low emissions, increases are smaller and more spatially restricted—these statements are very likely (>90% probability or above).

- The sub-regional pattern, identifying Puketoi ki Tai, NorthernZone-Taumarunui, and other inland lowlands as change hotspots, is robust, with high to extremely high confidence for both present and future projections.
- Model agreement is strongest on the direction, timing, and seasonality of change; it is extremely likely that meaningful increases in TX30 will be limited to summer, and that winter and spring will remain almost entirely free of such events even by 2100.
- Confidence in the projected fine-scale spatial or annual maxima is only moderate: while hotspot regions are consistently identified, the precise magnitude of increases displays considerable model spread. This represents about as likely as not confidence in specific local maxima.

Overall, the synthesis supports extremely likely conclusions of region-wide increases in very hot days this century, with emissions uncertainty dominating late-century projections and strong seasonal and sub-regional modulation of risk.

14 Conclusions

The synthesis of climate projections for the number of very hot days (TX30, >30°C) in the Horizons region provides compelling evidence of a fundamental shift in the risk of extreme heat. Historically rare and highly seasonal, TX30 days are projected to become much more frequent by 2080–2099, with the degree of increase tightly linked to greenhouse gas emissions trajectory.

By mid-century, even under low or intermediate emission scenarios, and virtually certain under high emissions, the region will see more frequent very hot summer days, with increases occurring earliest, and most intensely, in northeast and interior sub-regions. While uncertainties exist in exact local values, the qualitative pattern of intensification and the emergence of regional hotspots is extremely robust across models and scenarios.

The impacts span public health (heat stress, emergency demand), agriculture (crop yield loss, livestock stress), ecosystems (drought, fire weather), and community wellbeing. Planning for urban heat resilience, water management, emergency services, and land-use regulation will become critical, particularly in the most affected sub-regions.

Projection uncertainties, particularly for local maxima, necessitate cautious interpretation but do not undermine the core message: adaptation is required and the need will accelerate in the absence of strong mitigation. The rarity of TX30 events in the historical record is no longer a reliable guide to future risk—the region must prepare for a markedly warmer and more extreme summer climate. Ongoing monitoring, ensemble-based risk assessment, and flexible adaptation strategy development are recommended as climate change accelerates. Detailed scenario- and sub-region-specific findings are available from Bodeker Scientific upon request.

15 Appendices

A map of the sub-regions reported on below is provided in Figure 30. Some of these sub-regions exhibit a 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 31. 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

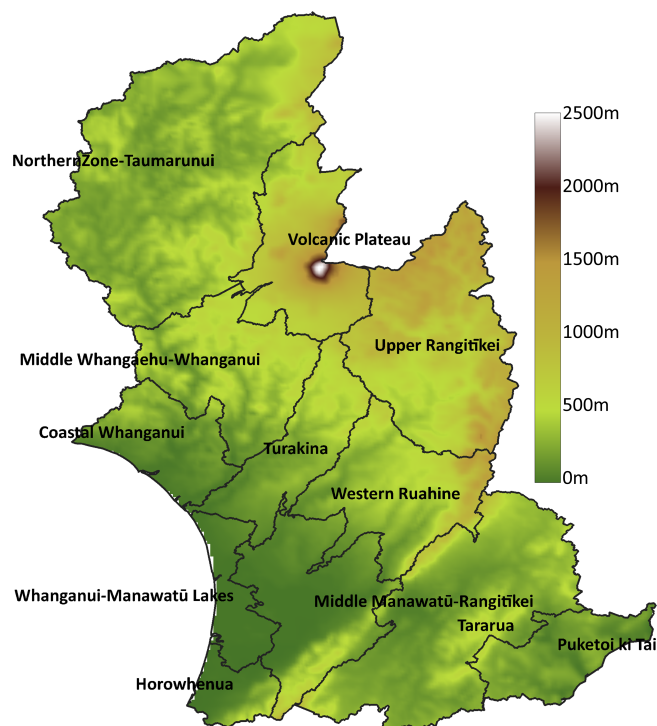


Figure 30: The 12 regions reported on below together with a map of the elevation (in metres) across the whole Horizons Region.

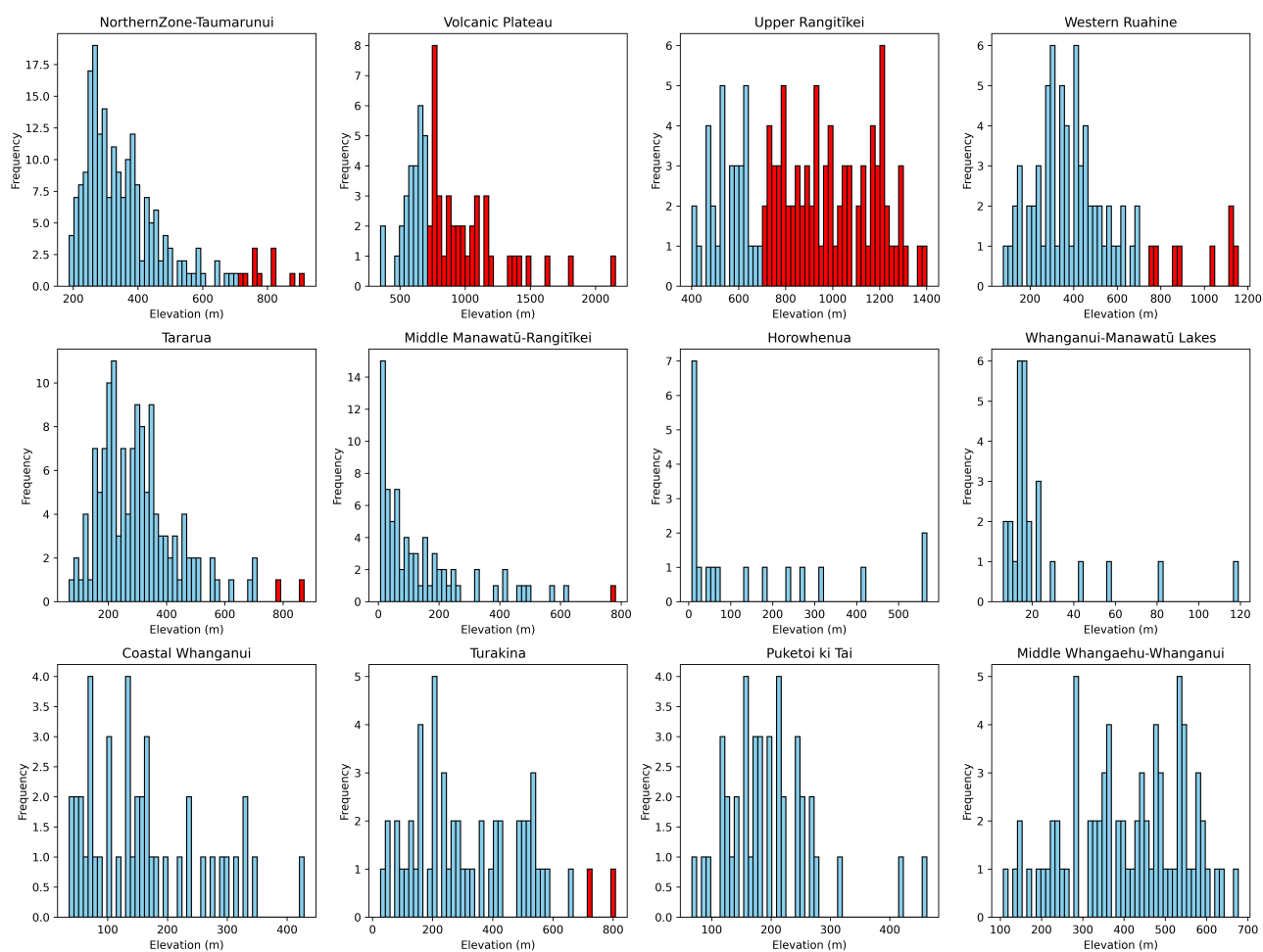


Figure 31: Histograms showing the number of CCAM model cells at each elevation. Histogram bars at elevations exceeding 700 m are shown in red. The original of this figure is available [here](#).



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 number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 32. The statistical summary of projected changes in the number of very hot days (>30°C)

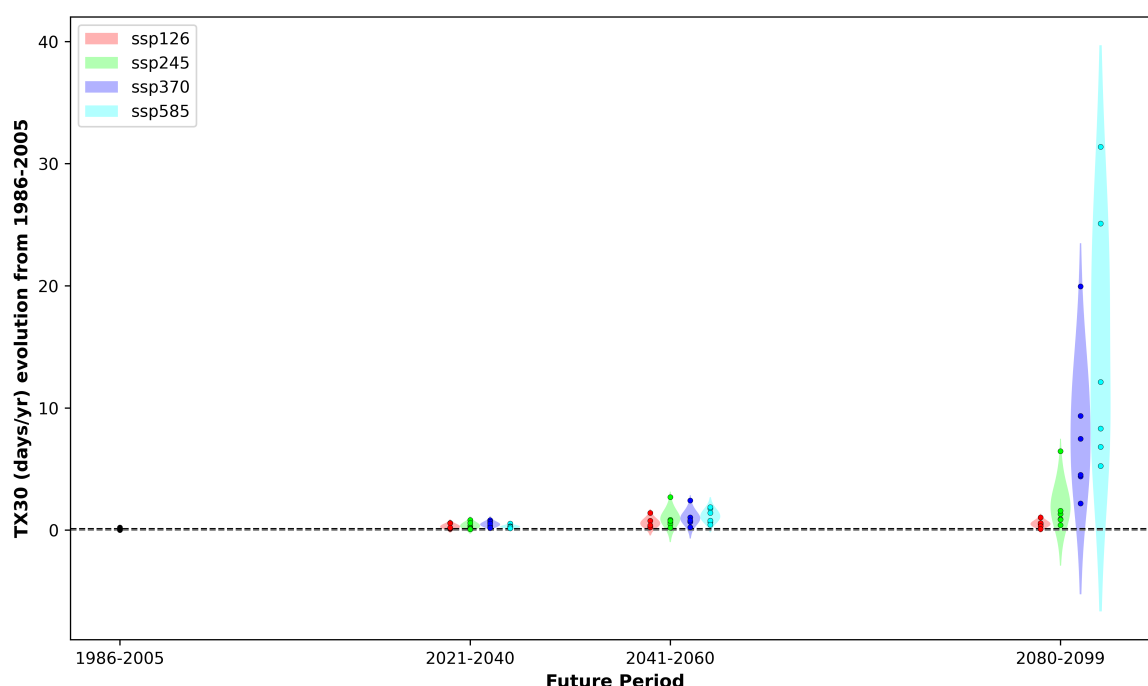


Figure 32: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the NorthernZone-Taumarunui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based 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](#).

over this region is shown in Table 1. The projected annual number of very hot days (>30°C) in NorthernZone-Taumarunui shows a distinct upward trend through the 21st century, most pronounced under higher emissions scenarios. For the baseline (1986–2005), very hot days are rare (mean less than 0.1 days/year). By 2021–2040, only minor changes are projected (all scenarios remain well below 1 day/year), with moderate and high agreement across models and scenarios (agreement: 46%).

Mid-century increases remain modest but more evident, with mean values under SSP370 and SSP585 nearing or slightly exceeding 1 day/year. The magnitude of change then diverges strongly by 2080–2099, depending on emissions: under SSP126, the mean remains below half a day/year, while SSP245 projects close to 2 days/year. Under SSP370 and SSP585, large increases are likely, with model means of around 8 and nearly 15 days/year, respectively. This late-century divergence is accompanied by a sharp rise in scenario and model spread (agreement: 11% across scenarios), especially under higher emission pathways.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.09 ± 0.09	0.09 ± 0.09	0.09 ± 0.09	0.09 ± 0.09
	2021-2040	0.20 ± 0.15	0.27 ± 0.25	0.38 ± 0.32	0.19 ± 0.19
	2041-2060	0.47 ± 0.35	0.85 ± 0.61	0.88 ± 0.68	1.06 ± 0.84
	2080-2099	0.42 ± 0.33	1.83 ± 1.23	7.89 ± 4.31	14.74 ± 6.94
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.21 ± 0.16	0.27 ± 0.25	0.38 ± 0.32	0.19 ± 0.19
	2041-2060	0.48 ± 0.36	0.87 ± 0.62	0.90 ± 0.69	1.08 ± 0.85
	2080-2099	0.42 ± 0.34	1.87 ± 1.26	8.08 ± 4.41	15.22 ± 7.13
Multi-model minimum	Baseline	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
	2021-2040	-0.03 ± 0.07	-0.05 ± 0.05	0.08 ± 0.10	0.00 ± 0.10
	2041-2060	0.07 ± 0.15	0.11 ± 0.13	0.13 ± 0.17	0.33 ± 0.36
	2080-2099	-0.01 ± 0.05	0.31 ± 0.30	2.09 ± 1.49	5.14 ± 3.44
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.13 ± 0.09	-0.16 ± 0.11	0.01 ± 0.06	-0.04 ± 0.09
	2041-2060	-0.18 ± 0.09	-0.38 ± 0.16	-0.17 ± 0.12	0.18 ± 0.31
	2080-2099	-0.05 ± 0.08	-1.28 ± 0.53	-1.00 ± 0.98	-0.47 ± 2.79
Multi-model maximum	Baseline	0.21 ± 0.15	0.21 ± 0.15	0.21 ± 0.15	0.21 ± 0.15
	2021-2040	0.55 ± 0.39	0.74 ± 0.64	0.75 ± 0.62	0.45 ± 0.33
	2041-2060	1.32 ± 0.85	2.61 ± 1.52	2.33 ± 1.74	1.89 ± 1.38
	2080-2099	0.96 ± 0.85	6.36 ± 3.69	19.86 ± 9.03	31.29 ± 11.30
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.59 ± 0.43	0.77 ± 0.65	0.80 ± 0.66	0.44 ± 0.33
	2041-2060	1.22 ± 0.81	2.24 ± 1.37	2.07 ± 1.52	2.08 ± 1.48
	2080-2099	0.96 ± 0.78	5.34 ± 3.18	18.44 ± 8.78	33.12 ± 12.63

Table 1: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



It is very likely NorthernZone-Taumarunui will experience more very hot days by century's end, with the largest increases under high-emissions futures. However, the level of inter-model and inter-scenario agreement decreases markedly in late-century projections, indicating low confidence in the precise magnitude of change under these scenarios.

15.1.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 33. The statistical summary of projected changes in the number of very hot days (>30°C) over

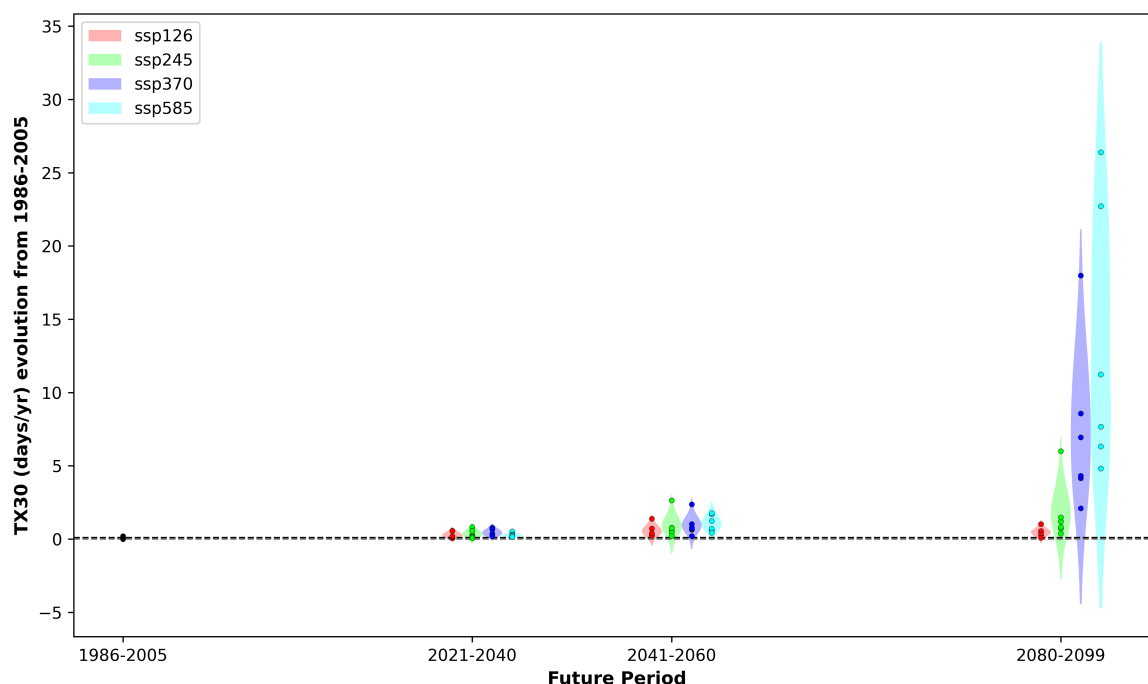


Figure 33: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the NorthernZone-Taumarunui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).

this region is shown in Table 2. Projections for the NorthernZone-Taumarunui sub-region show a very likely increase in the number of very hot summer days (>30°C) over the 21st century. Multi-model mean values for TX30 rise from near baseline levels (approximately 0.1 days/year) to higher values across all SSP scenarios, with the strongest increases under high-emissions scenarios. By 2080–2099, the multi-model mean under SSP1-2.6 remains less than 0.5 days/year, but increases to about 1.7 days/year under SSP2-4.5, and dramatically to over 7 and 13 days/year under SSP3-7.0 and SSP5-8.5, respectively. Spatial variability increases substantially in the high emissions scenarios, with standard deviations exceeding 5.9 days/year for SSP5-8.5 by century's end, indicating likely substantial subregional differences.

Model agreement is moderate (54%) in the near term (2021–2040), declining through the century, reaching low agreement (less than 9%) by 2080–2099. The signal for increased TX30 is extremely likely under SSP3-7.0 and SSP5-8.5, with virtually certain increases in magnitude and regional spatial variability. There is more uncertainty in the magnitude of change under low and intermediate emissions due to lower absolute changes and higher inter-scenario variability. Overall, unless emissions are strongly mitigated, the NorthernZone-Taumarunui region can expect a substantial rise in the frequency and regional heterogeneity of very hot summer days, with low confidence in scenario agreement towards century's end.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.09 ± 0.09	0.09 ± 0.09	0.09 ± 0.09	0.09 ± 0.09
	2021-2040	0.19 ± 0.14	0.26 ± 0.23	0.34 ± 0.29	0.18 ± 0.18
	2041-2060	0.45 ± 0.33	0.81 ± 0.56	0.86 ± 0.64	0.99 ± 0.77
	2080-2099	0.37 ± 0.30	1.68 ± 1.10	7.25 ± 3.85	13.10 ± 5.96
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.20 ± 0.15	0.26 ± 0.24	0.35 ± 0.30	0.18 ± 0.18
	2041-2060	0.46 ± 0.34	0.82 ± 0.57	0.87 ± 0.65	1.01 ± 0.78
	2080-2099	0.38 ± 0.30	1.72 ± 1.13	7.43 ± 3.93	13.55 ± 6.13
Multi-model minimum	Baseline	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
	2021-2040	-0.05 ± 0.07	-0.05 ± 0.05	0.07 ± 0.09	0.00 ± 0.09
	2041-2060	0.06 ± 0.14	0.10 ± 0.13	0.11 ± 0.16	0.32 ± 0.36
	2080-2099	-0.01 ± 0.05	0.29 ± 0.29	2.01 ± 1.41	4.70 ± 3.04
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.13 ± 0.09	-0.17 ± 0.11	-0.02 ± 0.05	-0.05 ± 0.09
	2041-2060	-0.18 ± 0.09	-0.41 ± 0.16	-0.18 ± 0.12	0.16 ± 0.30
	2080-2099	-0.10 ± 0.10	-1.22 ± 0.48	-0.67 ± 0.98	0.27 ± 2.84
Multi-model maximum	Baseline	0.21 ± 0.15	0.21 ± 0.15	0.21 ± 0.15	0.21 ± 0.15
	2021-2040	0.53 ± 0.36	0.74 ± 0.63	0.72 ± 0.60	0.45 ± 0.32
	2041-2060	1.30 ± 0.81	2.55 ± 1.46	2.28 ± 1.66	1.80 ± 1.26
	2080-2099	0.94 ± 0.82	5.91 ± 3.29	17.90 ± 7.87	26.30 ± 8.83
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.57 ± 0.40	0.76 ± 0.63	0.77 ± 0.63	0.44 ± 0.32
	2041-2060	1.19 ± 0.76	2.17 ± 1.29	2.02 ± 1.45	1.96 ± 1.36
	2080-2099	0.90 ± 0.73	4.95 ± 2.85	16.66 ± 7.66	28.68 ± 10.31

Table 2: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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 number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 34. The statistical summary of projected changes in the number of very hot days (>30°C)

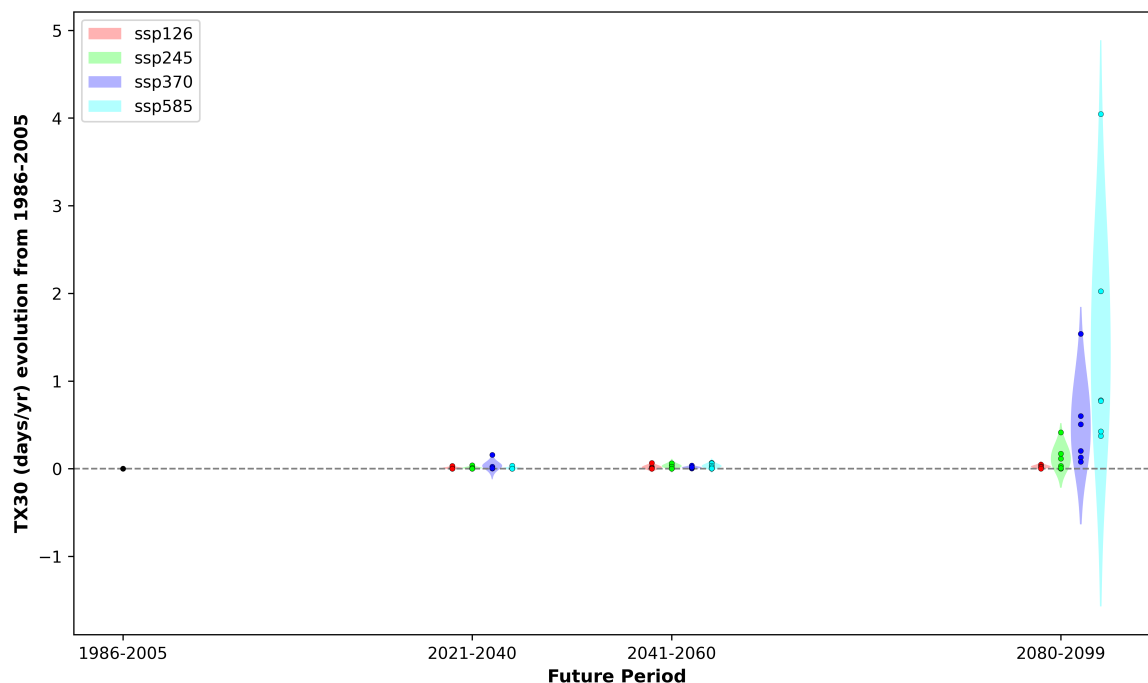


Figure 34: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the NorthernZone-Taumarunui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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 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](#).

over this region is shown in Table 3. In the NorthernZone-Taumarunui region, projections indicate a likely increase in the number of very hot days (maximum temperature >30°C) in autumn through the 21st century. For the near and mid-term (2021–2040 and 2041–2060), changes are very small across all emission scenarios, and the annual number of very hot days is likely to remain close to baseline conditions, with extremely likely agreement across models and scenarios. By the late century (2080–2099), more substantial increases emerge, dependent on emissions. Under the high-emissions scenario (SSP585), the multi-model mean projects over one additional very hot day per year, while intermediate pathways (SSP245 and SSP370) show lower but non-negligible increases, and the low-emission scenario (SSP126) projects minimal change. This response is very likely, with inter-model spread growing notably by 2080–2099, reflecting higher uncertainty, particularly under SSP585, as illustrated by wider model distributions. The spatial variability in projected changes also grows for higher emissions, though even for SSP585 it remains below one day per year on average. Agreement between scenarios diminishes markedly by late century, as scenario-driven differences dominate. Overall, it is virtually certain that any increase in extreme heat will be modest in the near term, with the likelihood of higher increases tied closely to emissions pathways in the longer term.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.2 Region: Volcanic Plateau

Area: 1664.65 km²



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.001	0.000 ± 0.001	0.000 ± 0.001	0.000 ± 0.001
	2021-2040	0.009 ± 0.010	0.010 ± 0.013	0.032 ± 0.025	0.007 ± 0.009
	2041-2060	0.017 ± 0.026	0.031 ± 0.031	0.015 ± 0.029	0.031 ± 0.039
	2080-2099	0.024 ± 0.025	0.123 ± 0.106	0.509 ± 0.390	1.404 ± 0.922
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.009 ± 0.010	0.010 ± 0.013	0.031 ± 0.024	0.007 ± 0.009
	2041-2060	0.018 ± 0.027	0.032 ± 0.031	0.015 ± 0.030	0.032 ± 0.040
	2080-2099	0.025 ± 0.026	0.128 ± 0.110	0.526 ± 0.402	1.446 ± 0.947
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	-0.000 ± 0.003	0.000 ± 0.003	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.003	0.000 ± 0.005	0.000 ± 0.003
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.072 ± 0.096	0.337 ± 0.321
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.012 ± 0.012	-0.015 ± 0.017	-0.063 ± 0.036	-0.014 ± 0.015
	2041-2060	-0.020 ± 0.019	-0.016 ± 0.014	-0.009 ± 0.014	-0.018 ± 0.017
	2080-2099	-0.011 ± 0.012	-0.103 ± 0.081	-0.260 ± 0.114	-0.583 ± 0.229
Multi-model maximum	Baseline	0.000 ± 0.003	0.000 ± 0.003	0.000 ± 0.003	0.000 ± 0.003
	2021-2040	0.034 ± 0.035	0.042 ± 0.050	0.158 ± 0.097	0.034 ± 0.038
	2041-2060	0.066 ± 0.074	0.080 ± 0.072	0.044 ± 0.081	0.084 ± 0.090
	2080-2099	0.061 ± 0.047	0.418 ± 0.359	1.540 ± 0.973	4.045 ± 2.215
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.030 ± 0.031	0.034 ± 0.042	0.120 ± 0.075	0.026 ± 0.030
	2041-2060	0.060 ± 0.073	0.084 ± 0.075	0.040 ± 0.072	0.085 ± 0.093
	2080-2099	0.063 ± 0.051	0.390 ± 0.322	1.419 ± 0.934	3.751 ± 2.153

Table 3: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



15.2.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 35. The statistical summary of projected changes in the number of very hot days (>30°C) over

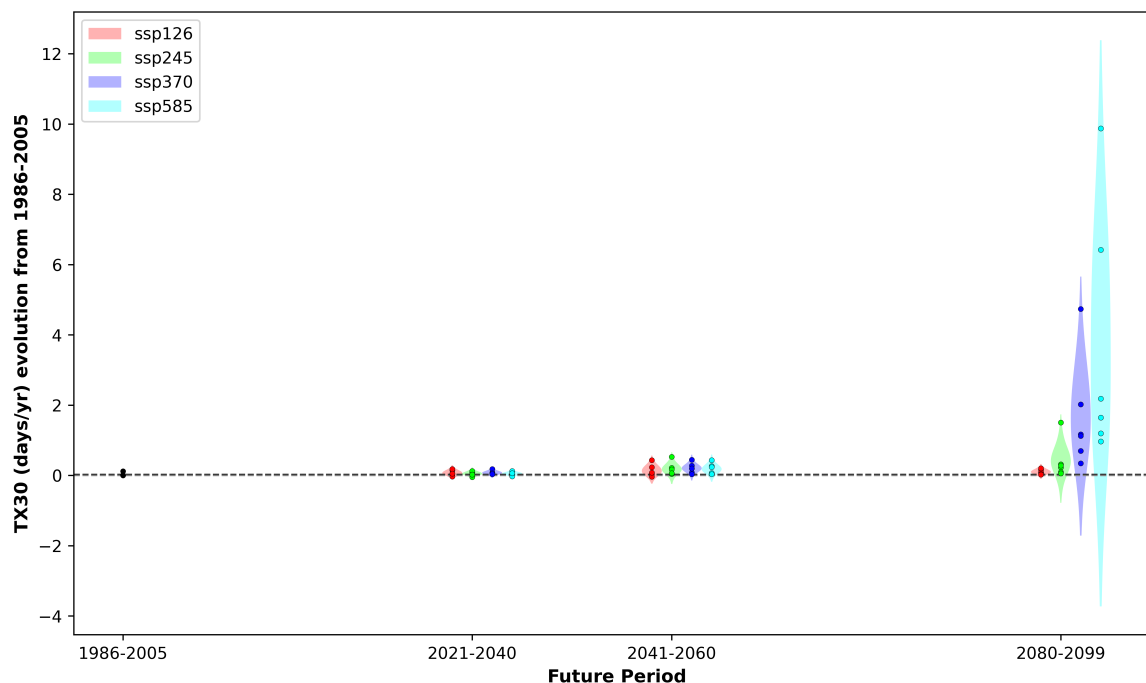


Figure 35: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Volcanic Plateau region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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](#).

this region is shown in Table 4. Projections for the Volcanic Plateau indicate a likely increase in the number of very hot days (>30°C) annually throughout the 21st century, with substantial scenario dependence emerging toward the century's end. Near-term changes (2021–2040) show only minimal increases—multi-model means remain below 0.1 days per year under all SSPs, and inter-scenario agreement (agreement across the four emission scenarios) is relatively high at over 75%, supporting medium confidence in modest change. Similarly, for 2041–2060, average increases remain under 0.2 days per year across all scenarios, maintaining high scenario agreement and medium confidence.

By 2080–2099, divergence between scenarios increases markedly. Under the highest emission pathway (SSP5-8.5), the multi-model mean projects almost 3.7 days per year above 30°C, while SSP1-2.6 remains near baseline values, and SSP3-7.0 projects just over 1.6 days. This scenario spread results in agreement across scenarios dropping to just over 22%, yielding low confidence in precise outcomes but a high likelihood of increases under higher emission futures. Model spread within scenarios also amplifies, particularly for the highest emissions, as shown by the expanding range in the violin plots and the spatial standard deviation rising above 3 days in SSP5-8.5. It is extremely likely that the Volcanic Plateau will experience more very hot days if emissions are not mitigated.

15.2.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 36. The statistical summary of projected changes in the number of very hot days (>30°C) over



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.023 ± 0.023	0.023 ± 0.023	0.023 ± 0.023	0.023 ± 0.023
	2021-2040	0.049 ± 0.060	0.029 ± 0.065	0.054 ± 0.078	0.033 ± 0.050
	2041-2060	0.112 ± 0.122	0.156 ± 0.193	0.183 ± 0.190	0.159 ± 0.221
	2080-2099	0.079 ± 0.111	0.391 ± 0.380	1.659 ± 1.771	3.693 ± 3.378
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.052 ± 0.061	0.031 ± 0.067	0.055 ± 0.079	0.033 ± 0.050
	2041-2060	0.117 ± 0.125	0.160 ± 0.197	0.186 ± 0.193	0.163 ± 0.224
	2080-2099	0.081 ± 0.113	0.400 ± 0.389	1.704 ± 1.815	3.819 ± 3.485
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.067 ± 0.058	-0.070 ± 0.057	-0.008 ± 0.049	-0.062 ± 0.056
	2041-2060	-0.060 ± 0.055	-0.024 ± 0.071	0.011 ± 0.039	-0.008 ± 0.074
	2080-2099	-0.017 ± 0.037	0.033 ± 0.083	0.310 ± 0.449	0.928 ± 1.185
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.074 ± 0.041	-0.070 ± 0.056	-0.041 ± 0.032	-0.059 ± 0.042
	2041-2060	-0.131 ± 0.082	-0.112 ± 0.081	-0.037 ± 0.034	-0.073 ± 0.063
	2080-2099	-0.048 ± 0.031	-0.357 ± 0.303	-0.578 ± 0.456	-1.396 ± 0.888
Multi-model maximum	Baseline	0.120 ± 0.090	0.120 ± 0.090	0.120 ± 0.090	0.120 ± 0.090
	2021-2040	0.177 ± 0.149	0.120 ± 0.183	0.171 ± 0.174	0.118 ± 0.111
	2041-2060	0.415 ± 0.364	0.508 ± 0.558	0.433 ± 0.463	0.412 ± 0.380
	2080-2099	0.233 ± 0.259	1.481 ± 1.378	4.726 ± 4.781	9.855 ± 7.898
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.193 ± 0.153	0.143 ± 0.194	0.160 ± 0.161	0.128 ± 0.108
	2041-2060	0.395 ± 0.336	0.458 ± 0.478	0.424 ± 0.423	0.422 ± 0.440
	2080-2099	0.224 ± 0.252	1.223 ± 1.141	4.289 ± 4.289	9.765 ± 8.054

Table 4: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

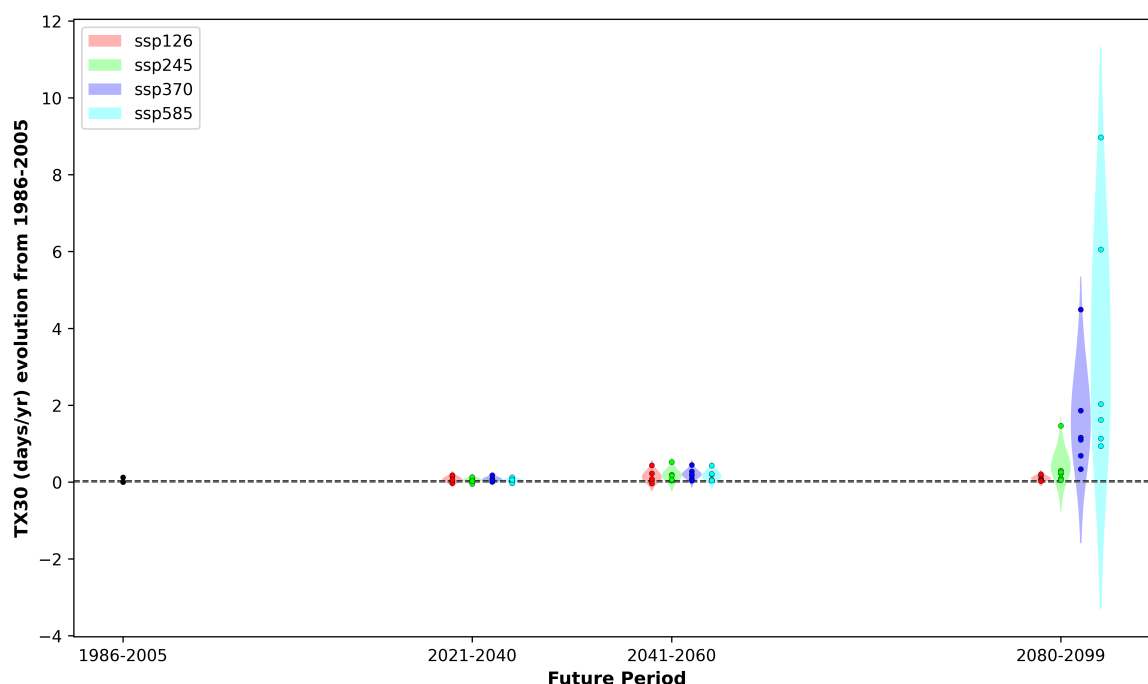


Figure 36: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Volcanic Plateau region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

this region is shown in Table 5. Projections for the Volcanic Plateau indicate a gradual increase in the annual number of very hot days (>30°C) through the 21st century, especially under higher emissions scenarios. During the baseline period, these events are extremely rare, with a multi-model mean near zero. For 2021-2040, all scenarios show minimal increases (means below 0.05 days/yr), with very high inter-scenario agreement (82.6%), and it is virtually certain that very hot days will remain uncommon in the near term.

For 2041-2060, the number increases slightly across all scenarios, though the magnitude remains modest (mean values below 0.2 days/yr), with high agreement (74%) and likely minor impacts. By 2080-2099, substantial divergence emerges. Under low-emissions (SSP1-2.6), very hot days remain rare (mean $\approx$ 0.07 days/yr). For medium emissions (SSP2-4.5), increases are limited (mean $\approx$ 0.4 days/yr), but under higher emissions (SSP3-7.0 and especially SSP5-8.5), substantial increases are projected—up to 3.4 days/yr for SSP5-8.5, with a wide range of possible outcomes. Disagreement across scenarios increases sharply (22% agreement), resulting in medium confidence for late-century outcomes. Inter-model spread within scenarios also grows markedly by century's end, especially for higher emissions, reflecting high uncertainty in extreme heat projections under strong climate forcing.

15.2.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 37. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 6. The projections for the Volcanic Plateau indicate that the number of very hot autumn days (>30°C) is projected to remain negligible through the 21st century under low and intermediate emissions scenarios (SSP1-2.6 and SSP2-4.5). Under these pathways, multi-model means for all time periods remain near zero days per year, signifying either extremely rare or absent very hot days. For higher emissions scenarios, particularly SSP3-7.0 and SSP5-8.5, increases emerge toward late century (2080–2099), with a multi-



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.023 ± 0.023	0.023 ± 0.023	0.023 ± 0.023	0.023 ± 0.023
	2021-2040	0.043 ± 0.056	0.026 ± 0.062	0.044 ± 0.068	0.031 ± 0.047
	2041-2060	0.111 ± 0.121	0.150 ± 0.182	0.178 ± 0.187	0.142 ± 0.207
	2080-2099	0.073 ± 0.102	0.375 ± 0.355	1.582 ± 1.663	3.433 ± 3.100
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.046 ± 0.057	0.028 ± 0.064	0.046 ± 0.069	0.032 ± 0.048
	2041-2060	0.116 ± 0.123	0.153 ± 0.186	0.180 ± 0.190	0.146 ± 0.210
	2080-2099	0.075 ± 0.104	0.384 ± 0.364	1.623 ± 1.703	3.551 ± 3.200
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.068 ± 0.057	-0.070 ± 0.057	-0.032 ± 0.055	-0.064 ± 0.056
	2041-2060	-0.060 ± 0.055	-0.024 ± 0.071	0.011 ± 0.039	-0.008 ± 0.074
	2080-2099	-0.018 ± 0.037	0.032 ± 0.082	0.303 ± 0.438	0.897 ± 1.116
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.082 ± 0.045	-0.070 ± 0.057	-0.058 ± 0.040	-0.061 ± 0.042
	2041-2060	-0.131 ± 0.082	-0.117 ± 0.085	-0.037 ± 0.035	-0.080 ± 0.064
	2080-2099	-0.056 ± 0.035	-0.355 ± 0.291	-0.520 ± 0.405	-1.195 ± 0.777
Multi-model maximum	Baseline	0.120 ± 0.090	0.120 ± 0.090	0.120 ± 0.090	0.120 ± 0.090
	2021-2040	0.177 ± 0.146	0.117 ± 0.183	0.170 ± 0.174	0.118 ± 0.111
	2041-2060	0.415 ± 0.364	0.504 ± 0.546	0.425 ± 0.461	0.407 ± 0.363
	2080-2099	0.233 ± 0.255	1.444 ± 1.300	4.475 ± 4.441	8.945 ± 6.934
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.189 ± 0.149	0.137 ± 0.190	0.163 ± 0.162	0.128 ± 0.108
	2041-2060	0.393 ± 0.332	0.450 ± 0.462	0.413 ± 0.419	0.396 ± 0.415
	2080-2099	0.217 ± 0.243	1.188 ± 1.074	4.046 ± 3.973	8.960 ± 7.225

Table 5: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.006 ± 0.007	0.003 ± 0.005	0.009 ± 0.012	0.001 ± 0.002
	2041-2060	0.001 ± 0.003	0.004 ± 0.007	0.000 ± 0.000	0.001 ± 0.005
	2080-2099	0.001 ± 0.003	0.008 ± 0.020	0.052 ± 0.081	0.142 ± 0.233
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.006 ± 0.006	0.003 ± 0.005	0.009 ± 0.012	0.001 ± 0.002
	2041-2060	0.001 ± 0.003	0.004 ± 0.007	0.000 ± 0.000	0.001 ± 0.005
	2080-2099	0.001 ± 0.003	0.008 ± 0.021	0.054 ± 0.085	0.146 ± 0.240
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.002 ± 0.009	0.014 ± 0.041
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.014 ± 0.015	-0.006 ± 0.010	-0.025 ± 0.033	-0.002 ± 0.007
	2041-2060	-0.002 ± 0.007	-0.005 ± 0.009	0.000 ± 0.000	-0.002 ± 0.006
	2080-2099	-0.001 ± 0.005	-0.012 ± 0.026	-0.050 ± 0.049	-0.136 ± 0.170
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.033 ± 0.035	0.014 ± 0.024	0.055 ± 0.073	0.005 ± 0.014
	2041-2060	0.005 ± 0.017	0.014 ± 0.024	0.000 ± 0.000	0.005 ± 0.018
	2080-2099	0.003 ± 0.012	0.037 ± 0.085	0.179 ± 0.233	0.536 ± 0.791
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.025 ± 0.026	0.011 ± 0.019	0.040 ± 0.053	0.003 ± 0.010
	2041-2060	0.004 ± 0.013	0.013 ± 0.022	0.000 ± 0.000	0.005 ± 0.016
	2080-2099	0.003 ± 0.011	0.031 ± 0.073	0.171 ± 0.231	0.461 ± 0.690

Table 6: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

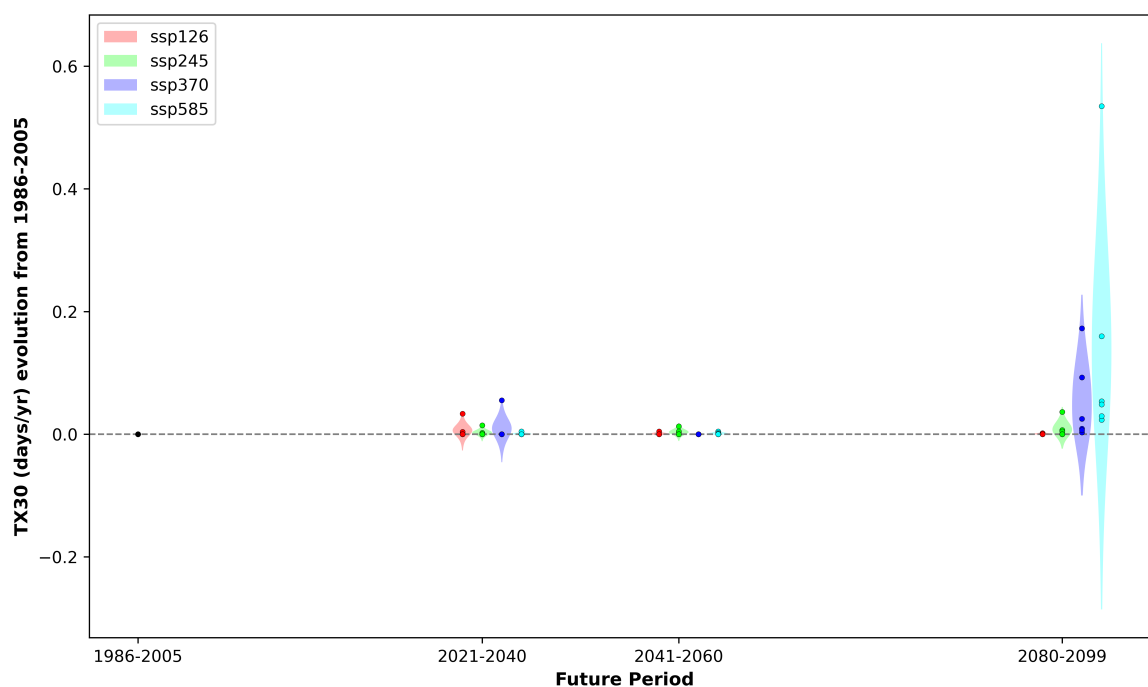


Figure 37: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Volcanic Plateau region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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 mean of 0.05 and 0.14 days/yr respectively, suggesting that very hot days will remain infrequent, but their occurrence is likely to increase under strong warming (likely, high confidence). The maximum individual model projections for 2080–2099 reach up to 0.18 days/yr (SSP3-7.0) and 0.54 days/yr (SSP5-8.5), though spatial variability is substantial, as indicated by the rising standard deviations. Inter-model agreement declines over time, with scenario agreement dropping from ~60% for 2021–2040 to ~36% by century’s end, reflecting growing uncertainty in magnitude and spatial distribution. Overall, it is very likely that most years will continue to see no very hot autumn days on the Volcanic Plateau, except potentially under extreme emissions, where low frequency occurrences are more likely (medium confidence).

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.3 Region: Upper Rangitikei

Area: 2694.06 km²

15.3.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 38. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 7. For Upper Rangitikei, the frequency of very hot days (>30°C) is projected to remain rare under all emission scenarios through to mid-century. Baseline values are low, near zero days per year. For 2021–2040 and 2041–2060, all scenarios show only a minor increase, with multi-model means remaining well below one day per year, indicating it is very likely that very hot days will remain infrequent through the middle of the century. Inter-model agreement is high in these periods (over 50% and 80% agreement respectively), with little divergence between pathways, supporting medium to high confidence in these



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02
	2021-2040	0.05 ± 0.07	0.06 ± 0.09	0.09 ± 0.11	0.04 ± 0.05
	2041-2060	0.16 ± 0.15	0.15 ± 0.18	0.19 ± 0.19	0.18 ± 0.22
	2080-2099	0.07 ± 0.09	0.40 ± 0.43	1.79 ± 1.99	3.99 ± 3.98
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.05 ± 0.07	0.06 ± 0.09	0.09 ± 0.11	0.04 ± 0.05
	2041-2060	0.16 ± 0.16	0.16 ± 0.18	0.19 ± 0.19	0.18 ± 0.22
	2080-2099	0.07 ± 0.09	0.41 ± 0.44	1.84 ± 2.03	4.10 ± 4.09
Multi-model minimum	Baseline	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	2021-2040	-0.04 ± 0.05	-0.02 ± 0.03	0.00 ± 0.04	-0.04 ± 0.05
	2041-2060	-0.02 ± 0.06	-0.01 ± 0.06	0.05 ± 0.10	0.03 ± 0.10
	2080-2099	-0.01 ± 0.03	0.02 ± 0.06	0.55 ± 0.82	1.28 ± 1.64
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.06 ± 0.04	-0.06 ± 0.06	-0.03 ± 0.04	-0.05 ± 0.05
	2041-2060	-0.13 ± 0.10	-0.14 ± 0.11	0.02 ± 0.07	-0.05 ± 0.08
	2080-2099	-0.05 ± 0.03	-0.24 ± 0.31	-0.47 ± 0.47	-0.97 ± 0.90
Multi-model maximum	Baseline	0.07 ± 0.07	0.07 ± 0.07	0.07 ± 0.07	0.07 ± 0.07
	2021-2040	0.17 ± 0.15	0.20 ± 0.24	0.22 ± 0.19	0.12 ± 0.11
	2041-2060	0.52 ± 0.43	0.56 ± 0.56	0.38 ± 0.36	0.45 ± 0.45
	2080-2099	0.23 ± 0.21	1.29 ± 1.47	4.89 ± 5.40	10.31 ± 9.32
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.18 ± 0.17	0.19 ± 0.24	0.22 ± 0.20	0.12 ± 0.11
	2041-2060	0.50 ± 0.41	0.48 ± 0.47	0.39 ± 0.34	0.43 ± 0.44
	2080-2099	0.21 ± 0.20	1.12 ± 1.24	4.44 ± 4.73	9.88 ± 9.23

Table 7: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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 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).

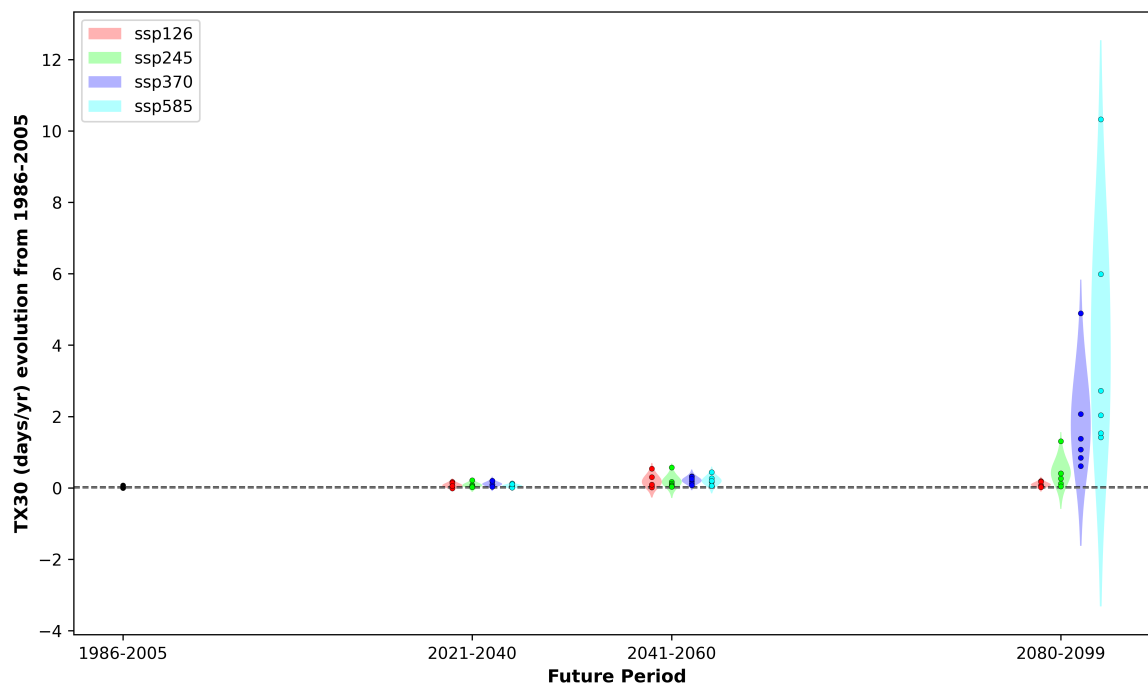


Figure 38: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Upper Rangitikei region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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 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](#).

projections.

By 2080–2099, projections diverge markedly by scenario. Under high emissions (SSP370/SSP585), substantial increases are seen, with means approaching 1.8 and 4 days per year, and maximum potential values exceeding 10 days/year for SSP585. This change is likely, though there is considerable inter-model and spatial variability, particularly for higher scenarios (low scenario agreement ~17%). Under lower emissions (SSP126/SSP245), the increase remains limited (<0.5 days/year). Thus, an increase in very hot days late in the century is likely under high emissions but unlikely under low emissions.

Overall, the evidence suggests very hot days will remain rare in Upper Rangitikei until late century, with a likely increase only under high-emissions scenarios, but substantial uncertainty surrounds these late-century projections.

15.3.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 39. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 8. Projections for the Upper Rangitikei indicate a very likely increase in the frequency of very hot days (>30°C) during summer by the late 21st century, especially under high emissions scenarios. The historical period (1986-2005) and early-to-mid 21st century (2021-2060) show near-zero change, with all scenarios maintaining less than 0.2 days per year. Model agreement is moderate for near-term projections (about 59% agreement for 2021-2040) but increases to nearly 89% for 2041-2060, reflecting consistent inter-model scenarios.

Towards the end of the century (2080-2099), the response diverges sharply by scenario. Under SSP1-2.6 and SSP2-4.5, projected increases remain below 0.4 days per year, with relatively small spatial variability and likely



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.019 ± 0.021	0.019 ± 0.021	0.019 ± 0.021	0.019 ± 0.021
	2021-2040	0.046 ± 0.063	0.055 ± 0.090	0.078 ± 0.095	0.039 ± 0.054
	2041-2060	0.151 ± 0.145	0.144 ± 0.161	0.174 ± 0.174	0.164 ± 0.200
	2080-2099	0.072 ± 0.087	0.386 ± 0.401	1.685 ± 1.841	3.637 ± 3.568
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.048 ± 0.065	0.057 ± 0.092	0.080 ± 0.097	0.038 ± 0.054
	2041-2060	0.156 ± 0.149	0.148 ± 0.165	0.176 ± 0.177	0.167 ± 0.203
	2080-2099	0.074 ± 0.088	0.394 ± 0.411	1.725 ± 1.880	3.745 ± 3.675
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.038 ± 0.045	-0.023 ± 0.031	0.003 ± 0.040	-0.039 ± 0.050
	2041-2060	-0.021 ± 0.055	-0.011 ± 0.050	0.035 ± 0.082	0.025 ± 0.100
	2080-2099	-0.016 ± 0.030	0.017 ± 0.053	0.518 ± 0.756	1.188 ± 1.499
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.066 ± 0.044	-0.064 ± 0.063	-0.034 ± 0.046	-0.054 ± 0.045
	2041-2060	-0.135 ± 0.096	-0.147 ± 0.123	0.009 ± 0.060	-0.055 ± 0.082
	2080-2099	-0.052 ± 0.033	-0.235 ± 0.292	-0.419 ± 0.437	-0.787 ± 0.775
Multi-model maximum	Baseline	0.072 ± 0.067	0.072 ± 0.067	0.072 ± 0.067	0.072 ± 0.067
	2021-2040	0.169 ± 0.153	0.198 ± 0.242	0.207 ± 0.159	0.123 ± 0.110
	2041-2060	0.524 ± 0.433	0.557 ± 0.560	0.358 ± 0.357	0.436 ± 0.420
	2080-2099	0.228 ± 0.211	1.248 ± 1.379	4.592 ± 4.960	9.172 ± 7.999
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.176 ± 0.169	0.190 ± 0.237	0.202 ± 0.174	0.125 ± 0.115
	2041-2060	0.482 ± 0.391	0.471 ± 0.464	0.353 ± 0.329	0.408 ± 0.400
	2080-2099	0.211 ± 0.195	1.084 ± 1.164	4.144 ± 4.346	8.904 ± 8.108

Table 8: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

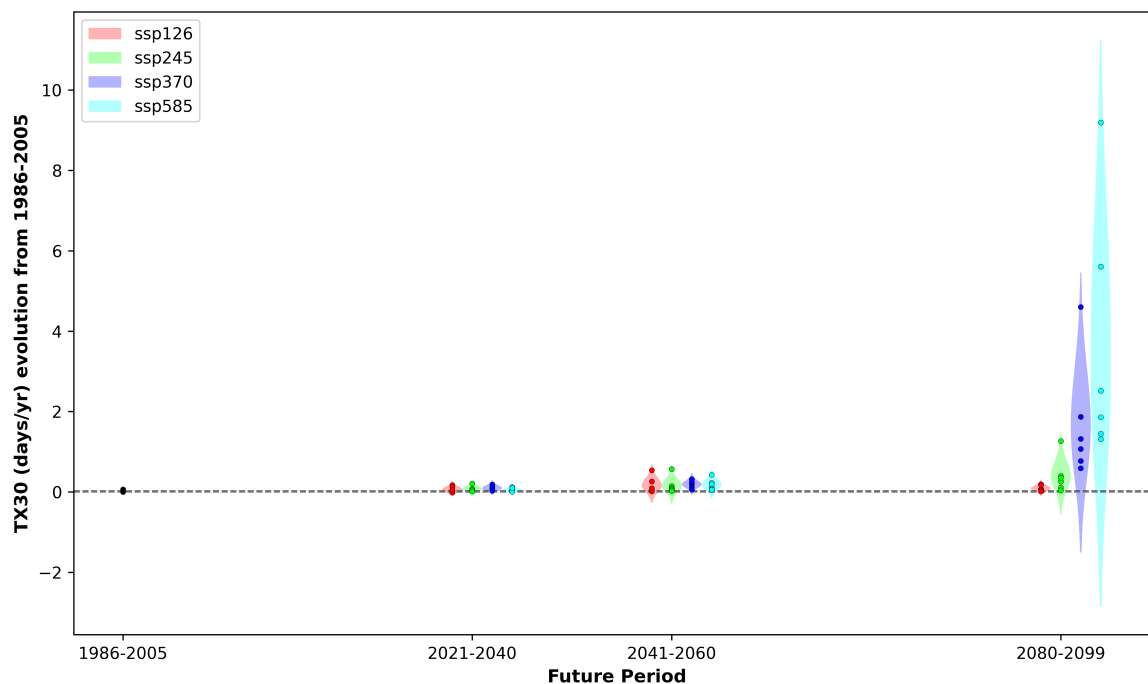


Figure 39: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Upper Rangitikei region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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](#).

low exposure. However, both SSP3-7.0 and especially SSP5-8.5 indicate much larger increases (around 1.7 and 3.6 days per year, respectively, multi-model mean), with maximums exceeding 4 and 9 days, and spatial standard deviations indicating substantial regional variation. Inter-model scenario agreement collapses to 17% in this period, signalling increased uncertainty. Yet the signal for strong increases under high emissions is robust across models, with extremely likely higher frequency of very hot days under SSP5-8.5. In summary, unless emissions are aggressively mitigated, projections indicate a marked increase in severe heat events across Upper Rangitikei by century's end.

15.3.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 40. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 9. Projections for the number of very hot days (>30°C) in autumn over Upper Rangitikei show limited change through mid-century, with a potential increase by late century under higher emission scenarios. All scenarios indicate a multi-model mean near zero days per year in the baseline period (1986–2005), with negligible increases (<0.01 days/yr) projected for 2021–2040 and 2041–2060 across all SSPs. These small projected changes agree with the absence of very hot autumn days historically. Towards 2080–2099, a strong scenario dependence emerges: low (SSP126) and intermediate (SSP245) scenarios maintain means close to zero, while high (SSP370 and SSP585) scenarios suggest a likely increase. Under SSP585, the multi-model mean reaches 0.22 days/yr, with a maximum modelled value of 0.83 days/yr and substantially greater spatial variability (stdv up to 0.36 days/yr), highlighting localised risk. Inter-model agreement is moderate to low, with only about one third agreement across scenarios for late-century projections, reflecting higher uncertainty under extreme warming. In summary, it is virtually certain that very hot autumn days will remain rare in Upper Rangitikei this century under low and intermediate emission pathways, but it is likely—albeit with low confidence—that increases could occur under extreme emissions, especially after 2080.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.006 ± 0.008	0.001 ± 0.003	0.010 ± 0.015	0.000 ± 0.001
	2041-2060	0.006 ± 0.009	0.004 ± 0.012	0.004 ± 0.008	0.003 ± 0.009
	2080-2099	0.000 ± 0.002	0.009 ± 0.026	0.073 ± 0.113	0.222 ± 0.356
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.006 ± 0.008	0.001 ± 0.003	0.010 ± 0.014	0.000 ± 0.001
	2041-2060	0.006 ± 0.010	0.005 ± 0.012	0.004 ± 0.008	0.003 ± 0.009
	2080-2099	0.000 ± 0.002	0.010 ± 0.027	0.076 ± 0.116	0.228 ± 0.364
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.005	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.003 ± 0.017	0.051 ± 0.103
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.014 ± 0.018	-0.001 ± 0.005	-0.027 ± 0.039	-0.000 ± 0.002
	2041-2060	-0.012 ± 0.018	-0.003 ± 0.008	-0.005 ± 0.011	-0.005 ± 0.012
	2080-2099	-0.001 ± 0.005	-0.012 ± 0.031	-0.064 ± 0.067	-0.191 ± 0.210
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.034 ± 0.044	0.003 ± 0.012	0.061 ± 0.087	0.000 ± 0.005
	2041-2060	0.032 ± 0.047	0.013 ± 0.027	0.014 ± 0.028	0.014 ± 0.036
	2080-2099	0.002 ± 0.010	0.039 ± 0.108	0.254 ± 0.354	0.831 ± 1.156
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.025 ± 0.032	0.003 ± 0.010	0.044 ± 0.063	0.000 ± 0.004
	2041-2060	0.026 ± 0.039	0.013 ± 0.026	0.013 ± 0.025	0.011 ± 0.030
	2080-2099	0.002 ± 0.008	0.033 ± 0.090	0.233 ± 0.318	0.689 ± 0.982

Table 9: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

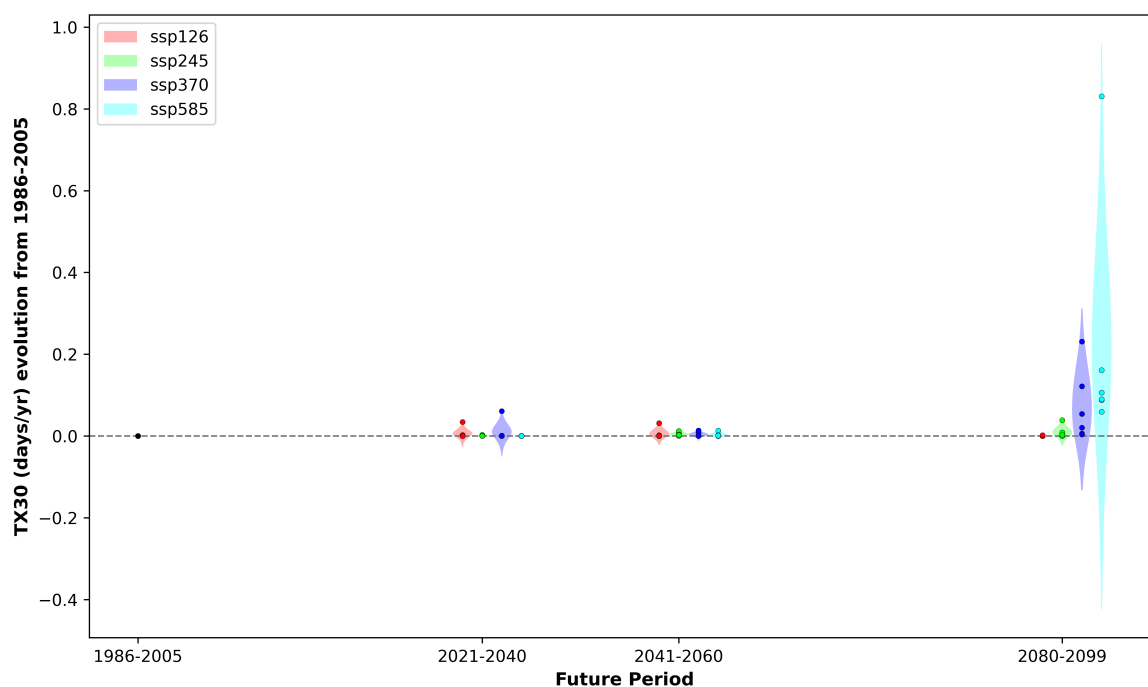


Figure 40: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Upper Rangitikei region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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 results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.4 Region: Western Ruahine

Area: 1758.32 km²

15.4.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 41. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 10. Projected changes in the annual number of very hot days (>30°C) across Western Ruahine indicate minimal increases through mid-century, regardless of emissions scenario. The multi-model mean suggests an increase from a negligible baseline (around 0 days per year) to less than 0.4 days per year by the 2041–2060 period, even under the highest emission pathway (SSP585). This evolution is very likely due to the low variance seen across both models and scenarios in the near- and mid-term, with strong consistency and robust inter-model agreement.

By the end of the century (2080–2099), signals begin to diverge appreciably depending on the emissions pathway. Under low emissions (SSP126), the multi-model mean remains low (<0.2 days/yr), while the highest pathway (SSP585) projects a substantial increase, with a mean near 8 days per year and individual models ranging from approximately 2.5 up to almost 20 days per year. Inter-model spread also grows significantly under high emissions, reflected in the increased standard deviation and broader range in the violin plots. This divergence suggests that, while increases are likely for higher emissions, the precise magnitude remains uncertain for late-century, though the probability of at least some increase is very likely.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03
	2021-2040	0.10 ± 0.07	0.09 ± 0.09	0.14 ± 0.15	0.07 ± 0.07
	2041-2060	0.17 ± 0.14	0.29 ± 0.24	0.31 ± 0.26	0.39 ± 0.33
	2080-2099	0.16 ± 0.14	0.77 ± 0.61	3.92 ± 2.56	8.07 ± 4.59
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.10 ± 0.07	0.09 ± 0.09	0.14 ± 0.16	0.07 ± 0.07
	2041-2060	0.18 ± 0.14	0.30 ± 0.25	0.31 ± 0.27	0.39 ± 0.33
	2080-2099	0.16 ± 0.14	0.79 ± 0.62	4.01 ± 2.61	8.33 ± 4.74
Multi-model minimum	Baseline	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01
	2021-2040	-0.05 ± 0.04	-0.05 ± 0.05	0.00 ± 0.06	-0.07 ± 0.04
	2041-2060	-0.04 ± 0.06	0.01 ± 0.11	0.10 ± 0.14	0.10 ± 0.14
	2080-2099	0.03 ± 0.06	0.09 ± 0.15	1.32 ± 0.90	2.53 ± 2.06
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.03	-0.11 ± 0.06	-0.05 ± 0.04	-0.07 ± 0.04
	2041-2060	-0.17 ± 0.08	-0.26 ± 0.15	-0.05 ± 0.07	0.07 ± 0.18
	2080-2099	-0.04 ± 0.04	-0.67 ± 0.44	-0.79 ± 0.34	-1.54 ± 1.12
Multi-model maximum	Baseline	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04
	2021-2040	0.30 ± 0.16	0.35 ± 0.26	0.36 ± 0.33	0.21 ± 0.17
	2041-2060	0.63 ± 0.41	1.07 ± 0.81	0.81 ± 0.68	0.73 ± 0.48
	2080-2099	0.41 ± 0.33	2.87 ± 2.11	10.56 ± 6.35	19.77 ± 8.77
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.29 ± 0.16	0.31 ± 0.22	0.35 ± 0.33	0.21 ± 0.16
	2041-2060	0.57 ± 0.36	0.92 ± 0.67	0.71 ± 0.58	0.76 ± 0.54
	2080-2099	0.37 ± 0.29	2.38 ± 1.76	9.45 ± 5.77	19.58 ± 9.53

Table 10: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

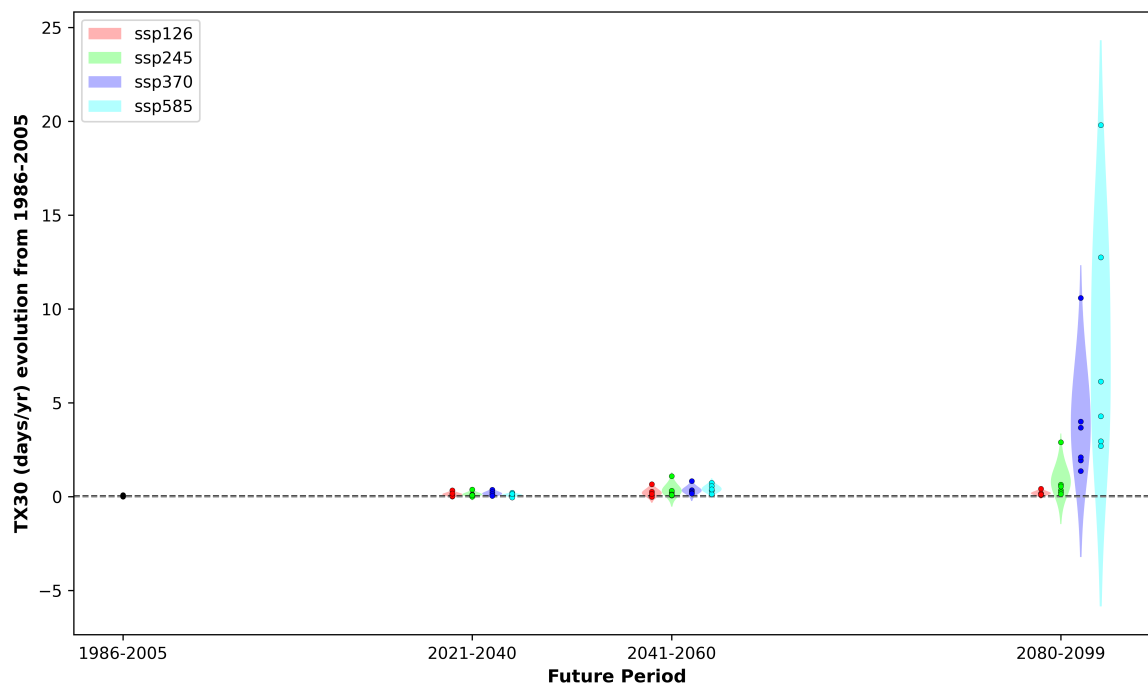


Figure 41: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Western Ruahine region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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](#).

Overall, very hot days are extremely unlikely to become frequent before late century, but their occurrence could increase markedly under high future emissions, with low confidence in magnitude due to increasing inter-model spread.

15.4.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 42. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 11. Projections for the Western Ruahine sub-region indicate a highly likely increase in the annual number of very hot days (>30°C) over the 21st century, especially under higher emissions scenarios. The statistical evidence shows that, relative to a baseline of nearly zero very hot days (multi-model mean ≈ 0 days/yr), only modest increases are projected by mid-century under all scenarios, with mean values remaining below 0.3 days/yr out to 2041–2060 for all scenarios. By late century (2080–2099), the increase diverges substantially between scenarios: under SSP1-2.6, the mean remains close to current levels (~ 0.15 days/yr), while under SSP3-7.0 and SSP5-8.5, the multi-model mean rises steeply to approximately 3.6 and 7.2 days/yr respectively. The inter-model spread and spatial variability also expand considerably in higher-emission scenarios, with some ensemble members exceeding 16 days/yr under SSP5-8.5.

Agreement is high among scenarios early in the century (agreement >70%), but declines dramatically by late century (<14%), underscoring scenario-dependent results. The consistency within low-emission projections is high, with limited spatial variation, whereas higher-emission pathways show very large inter-model and spatial variability. It is extremely likely that substantial increases in very hot days will materialise only under high-emission scenarios, while robust increases remain unlikely under strong mitigation.

Overall, these changes would represent a marked shift in Western Ruahine's future summer climate, with confidence increasing in the direction of change but scenario dependence indicating only likely outcomes under



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02
	2021-2040	0.09 ± 0.07	0.09 ± 0.08	0.12 ± 0.14	0.06 ± 0.07
	2041-2060	0.16 ± 0.13	0.25 ± 0.21	0.29 ± 0.25	0.35 ± 0.29
	2080-2099	0.15 ± 0.13	0.69 ± 0.52	3.58 ± 2.28	7.24 ± 4.00
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.10 ± 0.07	0.09 ± 0.08	0.12 ± 0.14	0.07 ± 0.07
	2041-2060	0.17 ± 0.13	0.26 ± 0.21	0.30 ± 0.25	0.35 ± 0.29
	2080-2099	0.15 ± 0.13	0.71 ± 0.54	3.66 ± 2.33	7.47 ± 4.14
Multi-model minimum	Baseline	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01	0.00 ± 0.01
	2021-2040	-0.05 ± 0.04	-0.05 ± 0.04	-0.03 ± 0.06	-0.07 ± 0.04
	2041-2060	-0.05 ± 0.06	-0.00 ± 0.09	0.09 ± 0.12	0.10 ± 0.14
	2080-2099	0.03 ± 0.06	0.04 ± 0.09	1.26 ± 0.85	2.29 ± 1.79
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.03	-0.11 ± 0.06	-0.08 ± 0.04	-0.07 ± 0.04
	2041-2060	-0.18 ± 0.09	-0.27 ± 0.15	-0.05 ± 0.06	0.05 ± 0.18
	2080-2099	-0.04 ± 0.04	-0.65 ± 0.43	-0.61 ± 0.31	-0.97 ± 1.13
Multi-model maximum	Baseline	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04
	2021-2040	0.30 ± 0.16	0.35 ± 0.26	0.34 ± 0.31	0.21 ± 0.17
	2041-2060	0.63 ± 0.41	1.01 ± 0.73	0.76 ± 0.64	0.68 ± 0.41
	2080-2099	0.41 ± 0.32	2.65 ± 1.89	9.50 ± 5.50	16.72 ± 7.08
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.29 ± 0.16	0.30 ± 0.21	0.34 ± 0.30	0.21 ± 0.16
	2041-2060	0.55 ± 0.35	0.85 ± 0.60	0.67 ± 0.55	0.68 ± 0.44
	2080-2099	0.36 ± 0.28	2.21 ± 1.57	8.49 ± 5.01	17.10 ± 8.09

Table 11: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

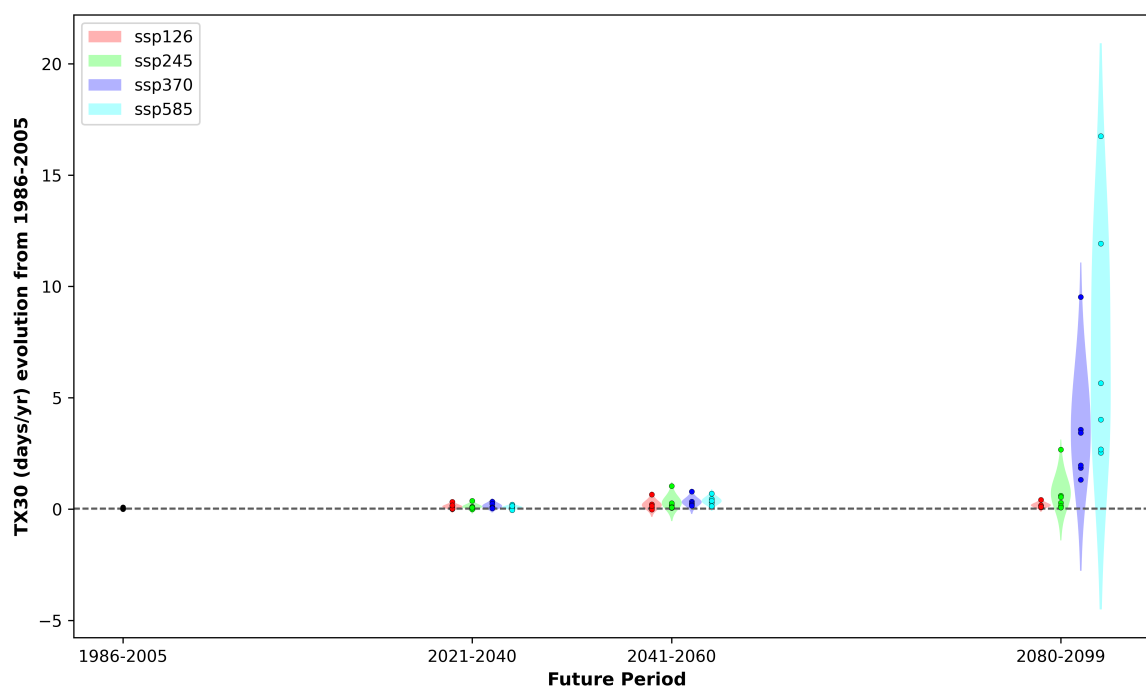


Figure 42: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Western Ruahine region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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](#).

higher emissions.

15.4.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 43. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 12. Projections for the Western Ruahine sub-region indicate that very hot autumn days (>30°C) will remain exceptionally rare through this century under all emissions scenarios. For the near- and mid-term (2021–2040 and 2041–2060), the multi-model mean changes in the annual number of very hot autumn days are negligibly small across all SSPs (less than 0.03 days/yr), with extremely likely high inter-model consistency and low spatial variability. For these periods, the changes are virtually certain to be climatically insignificant, supported by moderate scenario agreement (54–63%).

By late century (2080–2099), projections diverge more widely between scenarios. SSP126 and SSP245 continue to project minimal increases (well below one day/yr), while under SSP370 and particularly SSP585, larger increases are signalled, with the multi-model mean reaching about 0.72 days/yr under SSP585. However, even this remains well below one day/yr, indicating that very hot autumn days will likely remain rare. Spatial variability and inter-model spread increase substantially in high-emissions scenarios, reducing confidence—agreement across scenarios drops to approximately 23%. The projected changes under SSP370 and SSP585, while more pronounced, are likely but with only medium confidence due to the large inter-model range.

In summary, the signal for a substantial rise in very hot autumn days in Western Ruahine is more likely than not only under high emissions scenarios by century's end, but such events remain rare, and scenario dependence introduces substantial uncertainty.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.001	0.000 ± 0.001	0.000 ± 0.001	0.000 ± 0.001
	2021-2040	0.004 ± 0.005	0.003 ± 0.006	0.019 ± 0.015	0.001 ± 0.003
	2041-2060	0.015 ± 0.017	0.025 ± 0.035	0.013 ± 0.016	0.026 ± 0.037
	2080-2099	0.003 ± 0.008	0.076 ± 0.092	0.290 ± 0.246	0.716 ± 0.552
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.004 ± 0.005	0.003 ± 0.006	0.018 ± 0.015	0.001 ± 0.003
	2041-2060	0.015 ± 0.017	0.026 ± 0.036	0.013 ± 0.016	0.027 ± 0.038
	2080-2099	0.003 ± 0.008	0.077 ± 0.094	0.302 ± 0.254	0.735 ± 0.565
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.001 ± 0.008	-0.001 ± 0.006	-0.001 ± 0.008	-0.001 ± 0.008
	2041-2060	0.000 ± 0.000	0.002 ± 0.010	-0.001 ± 0.006	0.000 ± 0.000
	2080-2099	-0.001 ± 0.006	0.004 ± 0.016	0.027 ± 0.056	0.139 ± 0.163
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.012 ± 0.012	-0.005 ± 0.009	-0.037 ± 0.031	-0.004 ± 0.009
	2041-2060	-0.016 ± 0.013	-0.015 ± 0.018	-0.016 ± 0.016	-0.014 ± 0.017
	2080-2099	-0.004 ± 0.009	-0.032 ± 0.034	-0.176 ± 0.112	-0.526 ± 0.232
Multi-model maximum	Baseline	0.001 ± 0.008	0.001 ± 0.008	0.001 ± 0.008	0.001 ± 0.008
	2021-2040	0.025 ± 0.026	0.014 ± 0.022	0.091 ± 0.072	0.008 ± 0.018
	2041-2060	0.053 ± 0.041	0.070 ± 0.085	0.050 ± 0.051	0.074 ± 0.097
	2080-2099	0.011 ± 0.026	0.221 ± 0.244	0.895 ± 0.722	2.523 ± 1.590
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.019 ± 0.020	0.012 ± 0.020	0.071 ± 0.054	0.006 ± 0.014
	2041-2060	0.049 ± 0.042	0.072 ± 0.087	0.044 ± 0.044	0.072 ± 0.095
	2080-2099	0.010 ± 0.025	0.197 ± 0.220	0.846 ± 0.662	2.133 ± 1.394

Table 12: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

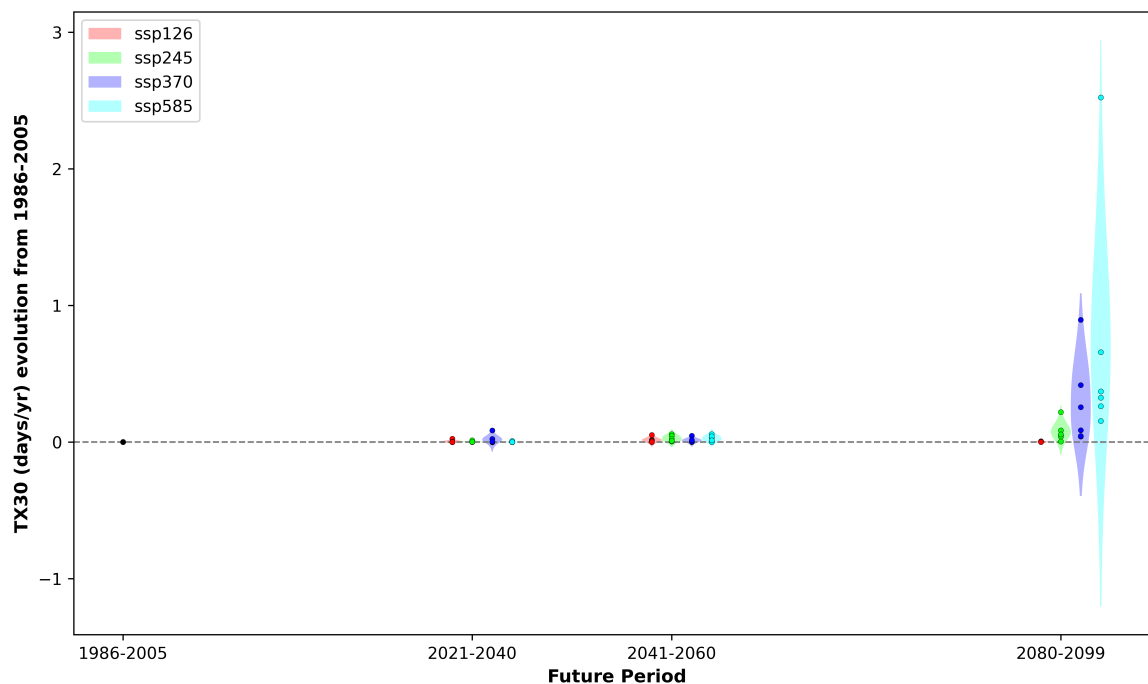


Figure 43: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Western Ruahine region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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](#).

15.5 Region: Tararua

Area: 3155.23 km²

15.5.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 44. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 13. Projections for Tararua indicate a substantial rise in the annual number of very hot days (>30°C), particularly under higher emissions scenarios by late century. Currently, very hot days are rare, with the baseline mean close to zero. For 2021–2040, only minor increases are projected across all scenarios (mean values all near zero), with very likely low to moderate increases and high inter-scenario agreement (52%). By 2041–2060, the mean increases reach approximately 0.4–0.8 days per year, with some divergence between scenarios but still relatively limited change and moderate agreement (37%).

The strongest signal emerges by 2080–2099, where under the high emissions scenario (SSP5-8.5), the multi-model mean rises to nearly 10 days/yr and the median to 10, while intermediate scenarios project 1–5 days/yr and the low emissions scenario remains near current levels. This indicates a likely and robust increase in extreme heat risk only under strong future warming, with the change virtually certain under SSP5-8.5. However, model spread also grows markedly in these projections (standard deviation up to 4 days/yr for SSP5-8.5), and inter-scenario agreement drops to just 10%, pointing to high scenario and model dependence for late-century outcomes. In summary, large increases in very hot days are extremely likely for Tararua only under continuing high global emissions.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.05 ± 0.04	0.05 ± 0.04	0.05 ± 0.04	0.05 ± 0.04
	2021-2040	0.19 ± 0.12	0.27 ± 0.18	0.37 ± 0.24	0.18 ± 0.11
	2041-2060	0.36 ± 0.26	0.57 ± 0.32	0.60 ± 0.37	0.77 ± 0.50
	2080-2099	0.34 ± 0.22	1.30 ± 0.73	5.27 ± 2.36	9.76 ± 4.01
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.19 ± 0.12	0.27 ± 0.19	0.38 ± 0.25	0.18 ± 0.11
	2041-2060	0.37 ± 0.26	0.58 ± 0.33	0.61 ± 0.38	0.78 ± 0.50
	2080-2099	0.34 ± 0.22	1.34 ± 0.75	5.38 ± 2.40	10.06 ± 4.11
Multi-model minimum	Baseline	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02
	2021-2040	-0.06 ± 0.04	0.03 ± 0.08	0.07 ± 0.10	-0.02 ± 0.06
	2041-2060	0.06 ± 0.12	0.10 ± 0.12	0.17 ± 0.20	0.34 ± 0.29
	2080-2099	0.10 ± 0.09	0.23 ± 0.25	1.94 ± 1.07	3.64 ± 2.08
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.10 ± 0.06	-0.03 ± 0.07	-0.05 ± 0.07	-0.05 ± 0.06
	2041-2060	-0.14 ± 0.12	-0.30 ± 0.14	-0.02 ± 0.10	0.28 ± 0.28
	2080-2099	-0.01 ± 0.07	-0.57 ± 0.30	-0.30 ± 0.32	-0.18 ± 1.11
Multi-model maximum	Baseline	0.12 ± 0.06	0.12 ± 0.06	0.12 ± 0.06	0.12 ± 0.06
	2021-2040	0.50 ± 0.28	0.62 ± 0.39	0.81 ± 0.46	0.41 ± 0.22
	2041-2060	0.92 ± 0.62	1.82 ± 0.93	1.40 ± 0.81	1.26 ± 0.68
	2080-2099	0.79 ± 0.52	3.89 ± 2.04	13.07 ± 5.47	21.05 ± 7.21
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.51 ± 0.28	0.60 ± 0.37	0.87 ± 0.50	0.43 ± 0.21
	2041-2060	0.95 ± 0.62	1.55 ± 0.80	1.30 ± 0.74	1.34 ± 0.77
	2080-2099	0.73 ± 0.46	3.45 ± 1.81	11.79 ± 4.96	21.74 ± 7.76

Table 13: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

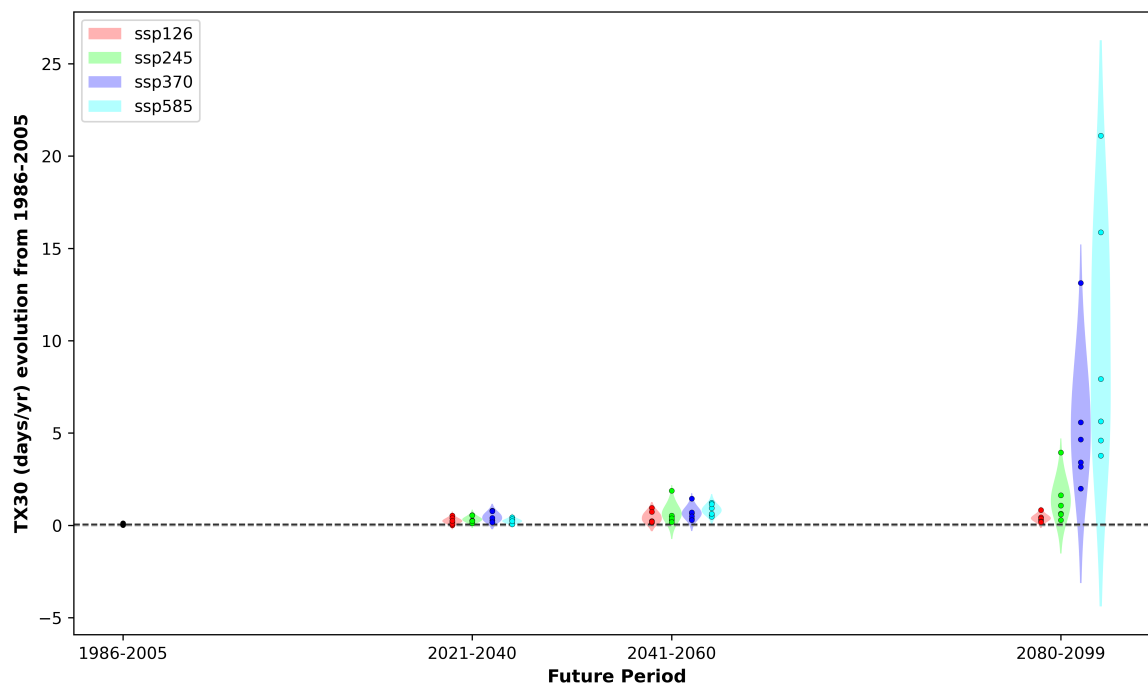


Figure 44: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Tararua region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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 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 number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 45. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 14. Projections for the Tararua sub-region indicate a likely increase in the annual number of very hot summer days (TX30, >30°C) throughout the 21st century, relative to the 1986–2005 baseline. Under low and medium emissions scenarios (SSP1-2.6, SSP2-4.5), changes are modest, with multi-model means remaining below two days per year even by 2100. Higher emission scenarios (SSP3-7.0 and especially SSP5-8.5) indicate more substantial increases: by 2080–2099, the mean reaches nearly 5 days for SSP3-7.0, and exceeds 8 days per year for SSP5-8.5, relative to historical levels. The increase is very likely under high emissions, while lower emissions pathways suggest only minimal increases.

Model agreement is strong in the near term (2021–2040) and for low emission pathways, indicating high confidence in small changes for these cases. However, agreement declines markedly between scenarios and models towards the end of the century (agreement across scenarios drops from about 59% to only 8%), especially under high emissions. This scatter reflects both inter-model variability and strong scenario dependence. The spatial standard deviation also increases, implying greater spatial variability across the region in the future, especially for higher warming scenarios. Overall, it is extremely likely that the frequency of very hot days will rise, with the magnitude and spatial heterogeneity strongly dependent on emissions pathway.

15.5.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 46. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 15. Projections for very hot days (>30°C) in Tararua during autumn indicate modest

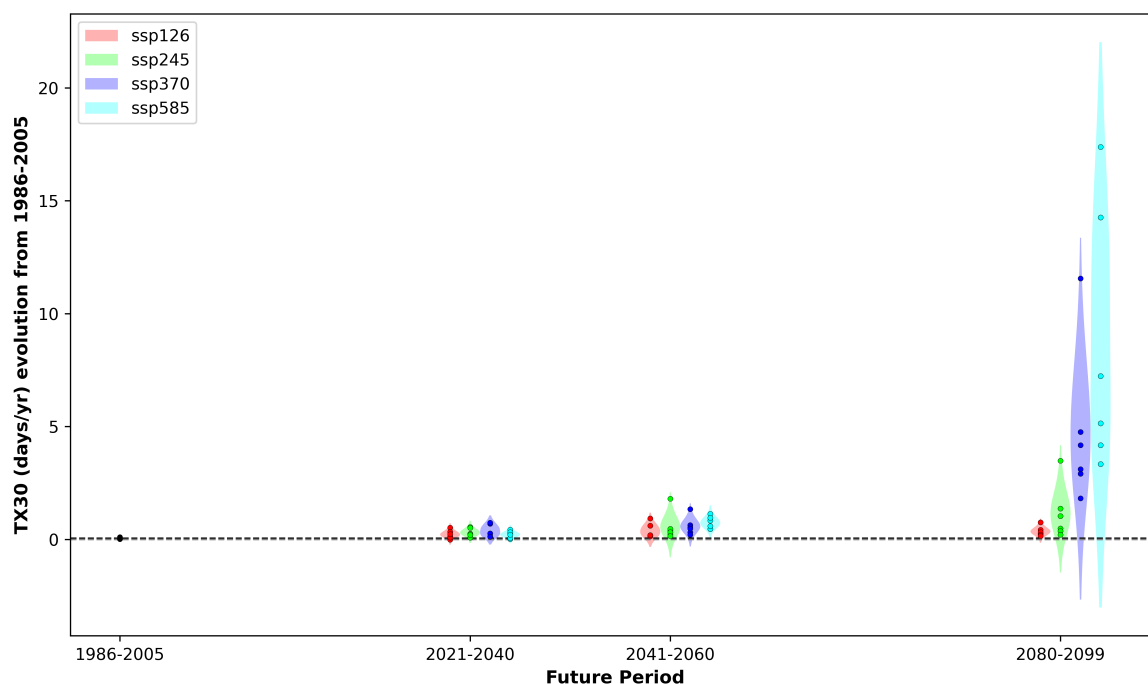


Figure 45: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Tararua region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in 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](#).

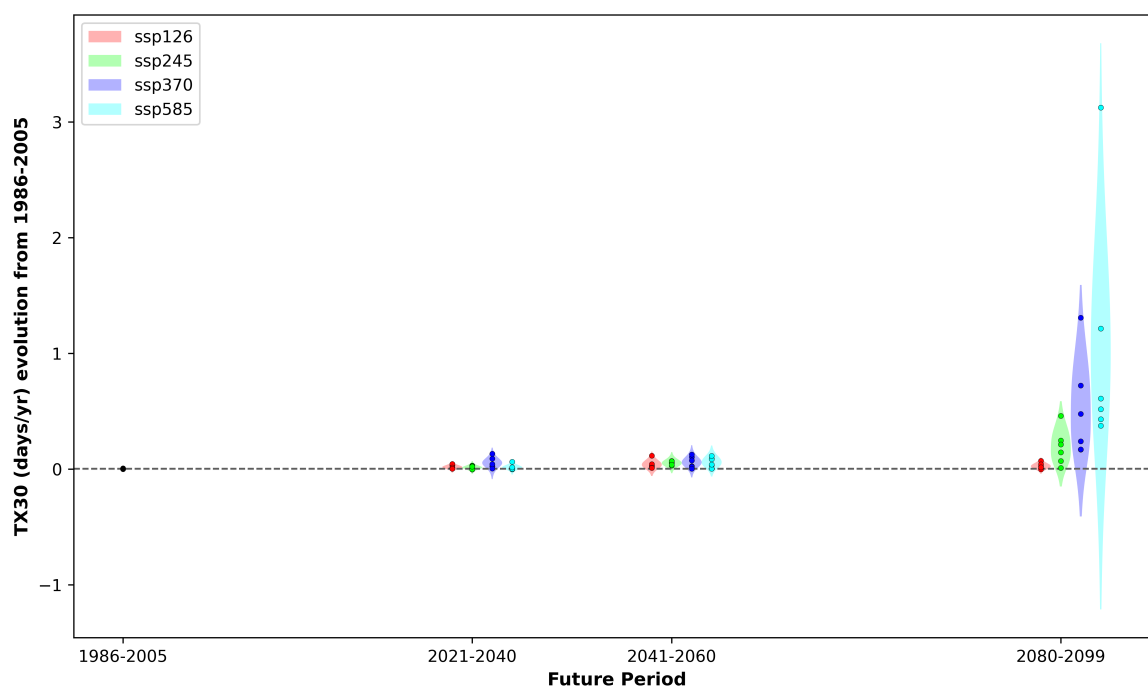


Figure 46: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Tararua region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained in 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	0.05 ± 0.04	0.05 ± 0.04	0.05 ± 0.04	0.05 ± 0.04
	2021-2040	0.17 ± 0.11	0.26 ± 0.17	0.32 ± 0.21	0.17 ± 0.11
	2041-2060	0.32 ± 0.23	0.51 ± 0.28	0.54 ± 0.32	0.69 ± 0.44
	2080-2099	0.31 ± 0.19	1.11 ± 0.62	4.67 ± 2.04	8.54 ± 3.37
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.17 ± 0.11	0.26 ± 0.17	0.33 ± 0.22	0.17 ± 0.11
	2041-2060	0.33 ± 0.23	0.52 ± 0.29	0.54 ± 0.32	0.70 ± 0.44
	2080-2099	0.31 ± 0.19	1.14 ± 0.64	4.76 ± 2.08	8.81 ± 3.47
Multi-model minimum	Baseline	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02
	2021-2040	-0.07 ± 0.05	0.02 ± 0.07	0.04 ± 0.07	-0.05 ± 0.04
	2041-2060	0.05 ± 0.10	0.07 ± 0.10	0.13 ± 0.16	0.31 ± 0.26
	2080-2099	0.09 ± 0.08	0.15 ± 0.19	1.76 ± 0.97	3.21 ± 1.75
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.11 ± 0.06	-0.04 ± 0.07	-0.09 ± 0.06	-0.08 ± 0.05
	2041-2060	-0.15 ± 0.12	-0.35 ± 0.15	-0.03 ± 0.08	0.25 ± 0.26
	2080-2099	-0.01 ± 0.06	-0.58 ± 0.30	-0.18 ± 0.31	0.30 ± 1.09
Multi-model maximum	Baseline	0.11 ± 0.05	0.11 ± 0.05	0.11 ± 0.05	0.11 ± 0.05
	2021-2040	0.49 ± 0.27	0.60 ± 0.35	0.74 ± 0.42	0.41 ± 0.21
	2041-2060	0.88 ± 0.60	1.75 ± 0.87	1.30 ± 0.73	1.13 ± 0.58
	2080-2099	0.72 ± 0.45	3.43 ± 1.78	11.51 ± 4.68	17.33 ± 5.71
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.49 ± 0.26	0.59 ± 0.34	0.81 ± 0.47	0.43 ± 0.21
	2041-2060	0.87 ± 0.57	1.48 ± 0.74	1.18 ± 0.64	1.19 ± 0.66
	2080-2099	0.66 ± 0.40	3.03 ± 1.56	10.33 ± 4.23	18.51 ± 6.35

Table 14: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.002 ± 0.005	0.002 ± 0.005	0.002 ± 0.005	0.002 ± 0.005
	2021-2040	0.015 ± 0.022	0.011 ± 0.014	0.051 ± 0.033	0.013 ± 0.010
	2041-2060	0.036 ± 0.031	0.050 ± 0.036	0.057 ± 0.060	0.058 ± 0.048
	2080-2099	0.023 ± 0.030	0.188 ± 0.115	0.512 ± 0.282	1.043 ± 0.567
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.015 ± 0.022	0.011 ± 0.014	0.050 ± 0.032	0.013 ± 0.010
	2041-2060	0.037 ± 0.032	0.050 ± 0.037	0.058 ± 0.061	0.060 ± 0.049
	2080-2099	0.023 ± 0.031	0.194 ± 0.118	0.528 ± 0.289	1.070 ± 0.579
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.006 ± 0.016	-0.010 ± 0.020	0.000 ± 0.017	-0.010 ± 0.020
	2041-2060	-0.000 ± 0.019	0.010 ± 0.021	-0.003 ± 0.012	-0.001 ± 0.020
	2080-2099	-0.005 ± 0.015	0.005 ± 0.024	0.121 ± 0.130	0.342 ± 0.289
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.016 ± 0.018	-0.023 ± 0.026	-0.037 ± 0.023	-0.026 ± 0.017
	2041-2060	-0.028 ± 0.020	-0.006 ± 0.018	-0.027 ± 0.024	-0.024 ± 0.026
	2080-2099	-0.020 ± 0.021	-0.046 ± 0.032	-0.121 ± 0.097	-0.435 ± 0.203
Multi-model maximum	Baseline	0.010 ± 0.021	0.010 ± 0.021	0.010 ± 0.021	0.010 ± 0.021
	2021-2040	0.049 ± 0.059	0.051 ± 0.055	0.151 ± 0.082	0.063 ± 0.035
	2041-2060	0.116 ± 0.080	0.110 ± 0.074	0.151 ± 0.145	0.150 ± 0.098
	2080-2099	0.071 ± 0.080	0.461 ± 0.282	1.306 ± 0.718	3.121 ± 1.360
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.048 ± 0.057	0.046 ± 0.052	0.133 ± 0.070	0.054 ± 0.033
	2041-2060	0.109 ± 0.075	0.110 ± 0.069	0.150 ± 0.143	0.152 ± 0.106
	2080-2099	0.071 ± 0.083	0.466 ± 0.271	1.268 ± 0.664	2.758 ± 1.260

Table 15: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



increases through mid-century, followed by larger rises by 2080–2099 under higher emissions scenarios. Across all scenarios and periods, the historical baseline frequency of such days is near zero, reflecting the rarity of >30°C events in the region. By 2021–2040 and 2041–2060 the multi-model means remain below 0.06 days/year for all scenarios, suggesting little change (likely). However, for 2080–2099, scenario-dependent divergence becomes pronounced: under SSP126, projected increases are minimal, remaining below 0.03 days/year (likely). Under higher emissions (SSP245, SSP370, SSP585), rises are more substantial—especially for SSP585, reaching a mean exceeding 1 very hot day per year, with notable spatial variability (standard deviations up to 0.57 days/year).

Model agreement is moderate for mid-century (scenario agreement 74% for 2041–2060, likely), but becomes poor by century's end (19% agreement), particularly as model spread and scenario divergence grow. This reflects high uncertainty in extreme-event projections at both the scenario and model level by late century.

In summary, it is extremely likely that very hot days will remain rare for Tararua in autumn until at least mid-century, but by 2100, a marked increase is likely only under high emissions, with low confidence in precise magnitudes due to high model and scenario spread.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.6 Region: Middle Manawatū-Rangitīkei

Area: 1838.51 km²

15.6.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986–2005 baseline over this region is shown in Figure 47. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 16. Projections indicate that the annual number of very hot days (>30°C) in Middle Manawatū-Rangitīkei is expected to rise over the 21st century. The baseline average is close to zero, indicating such events are rare at present. A modest increase is projected by 2040, remaining below 1 day per year for all emissions scenarios, with only minor inter-model spread and likely agreement among models in both low- and high-emission pathways. By mid-century (2041–2060), increases remain modest under SSP1-2.6 (very likely <1 day/yr), but rise to near 1 day under higher emission scenarios, with somewhat greater spatial variability and decreasing inter-scenario agreement.

For the late century (2080–2099), projections diverge markedly by emissions pathway. Under a low-emissions scenario (SSP1-2.6), the frequency of very hot days remains similar to mid-century levels, suggesting a likely continuation of low risk. By contrast, high-emission scenarios (especially SSP3-7.0 and SSP5-8.5) show a strong and spatially variable increase, with multi-model means of 6 and 11 days/yr, respectively. The range extends up to 14–23 days depending on the scenario and model, indicating very likely substantial warming under high emissions. Inter-model spread increases substantially in these scenarios, and model agreement drops to less than 10%, reflecting high uncertainty in absolute changes but high confidence in the direction of change—increased very hot days is virtually certain under high emissions.

15.6.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986–2005 baseline over this region is shown in Figure 48. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 17. The figure and supporting data indicate that the frequency of very hot days (>30°C) in Middle Manawatū-Rangitīkei during summer is projected to increase over the 21st century, with clear scenario-dependent divergence by 2080–2099. For the baseline (1986–2005), historical occurrence of

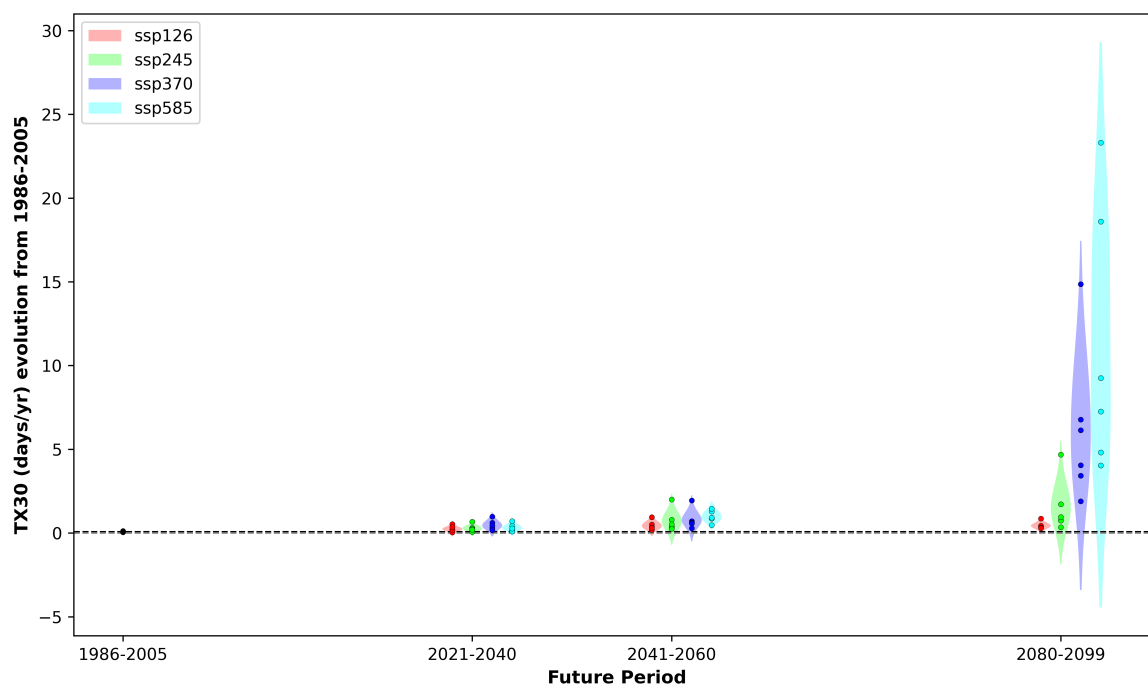


Figure 47: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Middle Manawatū-Rangitīkei region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based 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](#).

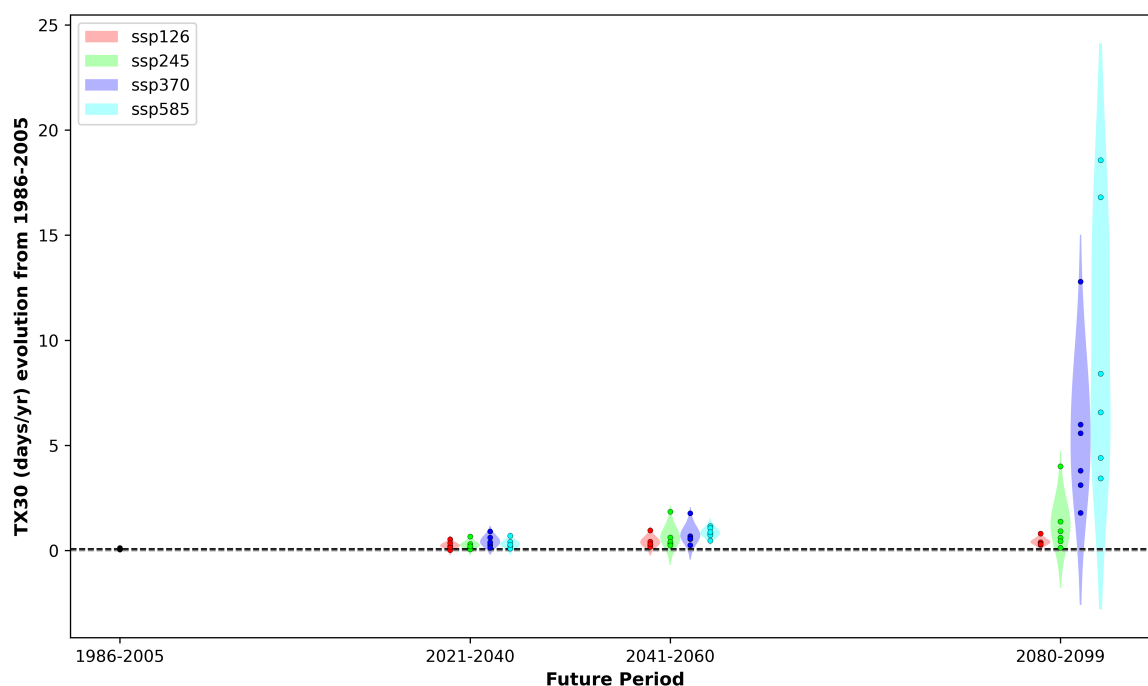


Figure 48: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Middle Manawatū-Rangitīkei region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.08 ± 0.05	0.08 ± 0.05	0.08 ± 0.05	0.08 ± 0.05
	2021-2040	0.17 ± 0.11	0.20 ± 0.11	0.39 ± 0.23	0.24 ± 0.17
	2041-2060	0.36 ± 0.23	0.64 ± 0.37	0.71 ± 0.46	0.90 ± 0.52
	2080-2099	0.36 ± 0.22	1.46 ± 0.77	6.11 ± 2.71	11.13 ± 4.46
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.17 ± 0.11	0.21 ± 0.11	0.39 ± 0.24	0.24 ± 0.18
	2041-2060	0.37 ± 0.23	0.66 ± 0.38	0.72 ± 0.47	0.91 ± 0.52
	2080-2099	0.36 ± 0.22	1.49 ± 0.79	6.25 ± 2.77	11.49 ± 4.59
Multi-model minimum	Baseline	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04
	2021-2040	-0.05 ± 0.05	-0.02 ± 0.07	0.08 ± 0.08	-0.00 ± 0.08
	2041-2060	0.09 ± 0.13	0.16 ± 0.14	0.19 ± 0.19	0.39 ± 0.33
	2080-2099	0.15 ± 0.12	0.26 ± 0.21	1.82 ± 0.81	3.95 ± 1.93
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.11 ± 0.06	-0.10 ± 0.07	-0.05 ± 0.06	-0.08 ± 0.05
	2041-2060	-0.03 ± 0.08	-0.27 ± 0.14	-0.11 ± 0.09	0.38 ± 0.33
	2080-2099	0.04 ± 0.06	-0.76 ± 0.27	-0.29 ± 0.51	0.03 ± 1.13
Multi-model maximum	Baseline	0.14 ± 0.08	0.14 ± 0.08	0.14 ± 0.08	0.14 ± 0.08
	2021-2040	0.49 ± 0.32	0.60 ± 0.27	0.91 ± 0.58	0.63 ± 0.39
	2041-2060	0.88 ± 0.53	1.93 ± 1.00	1.86 ± 1.16	1.43 ± 0.73
	2080-2099	0.78 ± 0.47	4.61 ± 2.15	14.79 ± 6.17	23.23 ± 8.11
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.45 ± 0.27	0.54 ± 0.25	0.89 ± 0.53	0.61 ± 0.37
	2041-2060	0.82 ± 0.47	1.69 ± 0.87	1.64 ± 1.02	1.51 ± 0.77
	2080-2099	0.71 ± 0.42	4.01 ± 1.93	13.70 ± 5.80	24.57 ± 8.87

Table 16: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr over the Middle Manawatū-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).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.08 ± 0.05	0.08 ± 0.05	0.08 ± 0.05	0.08 ± 0.05
	2021-2040	0.16 ± 0.11	0.18 ± 0.10	0.36 ± 0.22	0.23 ± 0.16
	2041-2060	0.33 ± 0.20	0.55 ± 0.31	0.66 ± 0.42	0.77 ± 0.43
	2080-2099	0.33 ± 0.19	1.17 ± 0.59	5.43 ± 2.37	9.62 ± 3.73
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.16 ± 0.11	0.19 ± 0.10	0.36 ± 0.22	0.23 ± 0.16
	2041-2060	0.33 ± 0.21	0.57 ± 0.32	0.67 ± 0.43	0.78 ± 0.44
	2080-2099	0.34 ± 0.19	1.20 ± 0.61	5.55 ± 2.42	9.96 ± 3.85
Multi-model minimum	Baseline	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04
	2021-2040	-0.06 ± 0.05	-0.03 ± 0.07	0.05 ± 0.06	-0.01 ± 0.07
	2041-2060	0.08 ± 0.12	0.14 ± 0.13	0.16 ± 0.16	0.38 ± 0.31
	2080-2099	0.13 ± 0.10	0.05 ± 0.08	1.71 ± 0.77	3.35 ± 1.58
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.12 ± 0.07	-0.12 ± 0.07	-0.06 ± 0.05	-0.10 ± 0.05
	2041-2060	-0.08 ± 0.07	-0.29 ± 0.15	-0.09 ± 0.09	0.38 ± 0.32
	2080-2099	0.04 ± 0.06	-0.78 ± 0.27	0.02 ± 0.56	0.58 ± 1.09
Multi-model maximum	Baseline	0.14 ± 0.08	0.14 ± 0.08	0.14 ± 0.08	0.14 ± 0.08
	2021-2040	0.49 ± 0.32	0.59 ± 0.27	0.84 ± 0.54	0.63 ± 0.39
	2041-2060	0.89 ± 0.54	1.77 ± 0.91	1.69 ± 1.02	1.14 ± 0.53
	2080-2099	0.73 ± 0.42	3.93 ± 1.75	12.72 ± 5.15	18.49 ± 6.21
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.45 ± 0.27	0.52 ± 0.24	0.84 ± 0.51	0.60 ± 0.36
	2041-2060	0.80 ± 0.46	1.51 ± 0.77	1.50 ± 0.90	1.22 ± 0.59
	2080-2099	0.66 ± 0.37	3.40 ± 1.56	11.85 ± 4.89	20.64 ± 7.25

Table 17: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr over the Middle Manawatū-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 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).



such events is extremely rare (~ 0.08 days/yr). Through the mid-21st century (2021–2040 and 2041–2060), all scenarios show only slight increases, remaining below one additional very hot day per year, with minimal distinction between scenarios and likely low to moderate climate impact.

By 2080–2099, inter-scenario differences are pronounced. Under high emission pathways (SSP370 and SSP585), the multi-model mean projects a likely substantial increase to approximately 5.4 and 9.6 very hot days per year, respectively, with individual models spanning from ~ 1.7 –12.7 (SSP370) and ~ 3.3 –18.5 (SSP585). Lower emission pathways (SSP126, SSP245) remain below two days per year. The spatial variability within the region becomes markedly larger at higher warming levels, particularly for SSP370 and SSP585, reflecting increased spatial heterogeneity.

Model agreement across scenarios diminishes over time, with only 7.6% agreement in 2080–2099, underscoring scenario dependency. Nevertheless, it is very likely that strong mitigation will minimise increases in extreme heat while high emissions will lead to frequent very hot days, with high confidence based on robust inter-model consistency within each scenario.

15.6.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986–2005 baseline over this region is shown in Figure 49. The statistical summary of projected changes in the number of very hot days (>30°C)

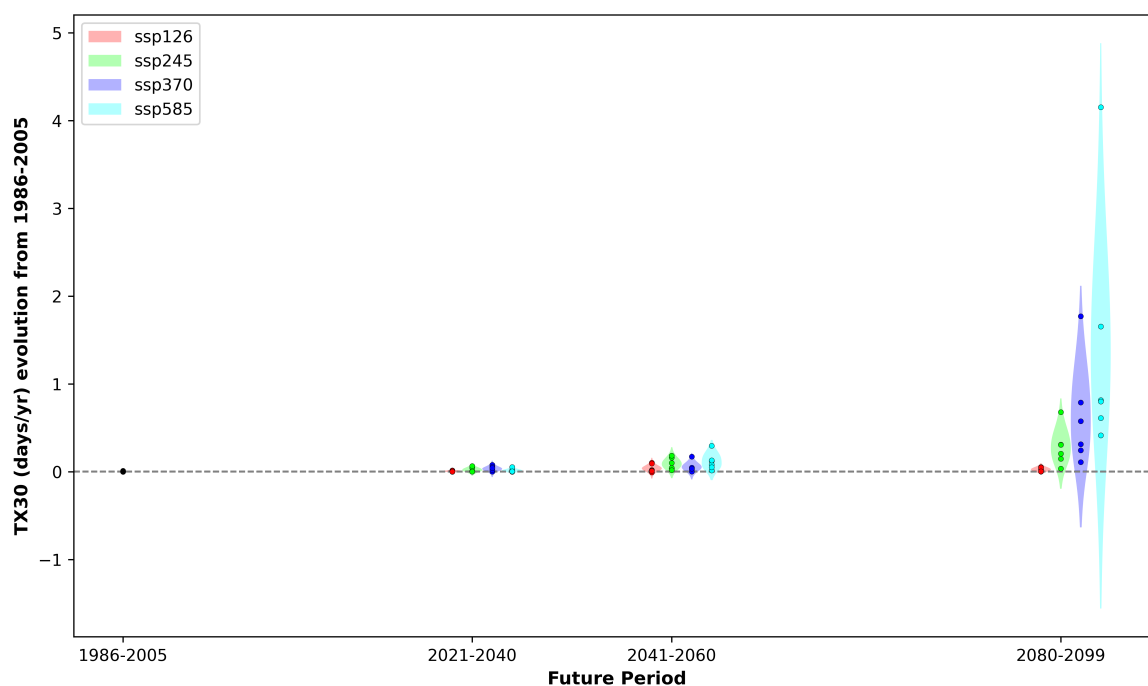


Figure 49: The time evolution of number of very hot days (>30°C) from the 1986–2005 baseline in units of days/yr over the Middle Manawatū-Rangitīkei region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).

over this region is shown in Table 18. Projections for the Middle Manawatū-Rangitīkei region indicate a likely increase in the number of very hot days (>30°C) during autumn compared to the 1986–2005 baseline. In the near term (2021–2040), multi-model means for all scenarios remain near zero, with only marginal increases (<0.04 days/yr), and scenario agreement is moderate (about as likely as not). By mid-century (2041–2060), a small but still minor rise is projected, with mean increases remaining below 0.12 days/yr across pathways, and agreement remains moderate.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.002 ± 0.005	0.002 ± 0.005	0.002 ± 0.005	0.002 ± 0.005
	2021-2040	0.004 ± 0.006	0.019 ± 0.011	0.031 ± 0.018	0.012 ± 0.016
	2041-2060	0.035 ± 0.027	0.088 ± 0.058	0.051 ± 0.048	0.113 ± 0.074
	2080-2099	0.024 ± 0.027	0.278 ± 0.170	0.631 ± 0.328	1.405 ± 0.706
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.004 ± 0.006	0.020 ± 0.011	0.030 ± 0.018	0.012 ± 0.016
	2041-2060	0.036 ± 0.027	0.090 ± 0.059	0.052 ± 0.048	0.117 ± 0.076
	2080-2099	0.025 ± 0.028	0.285 ± 0.174	0.650 ± 0.337	1.442 ± 0.721
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.007 ± 0.017	-0.008 ± 0.018	-0.003 ± 0.011	-0.005 ± 0.015
	2041-2060	-0.011 ± 0.021	0.007 ± 0.018	-0.001 ± 0.008	0.013 ± 0.026
	2080-2099	-0.001 ± 0.006	0.032 ± 0.045	0.095 ± 0.059	0.410 ± 0.314
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.012 ± 0.017	-0.025 ± 0.018	-0.028 ± 0.015	-0.018 ± 0.022
	2041-2060	-0.036 ± 0.026	-0.020 ± 0.021	-0.039 ± 0.031	-0.032 ± 0.040
	2080-2099	-0.016 ± 0.017	-0.037 ± 0.041	-0.223 ± 0.117	-0.536 ± 0.186
Multi-model maximum	Baseline	0.011 ± 0.021	0.011 ± 0.021	0.011 ± 0.021	0.011 ± 0.021
	2021-2040	0.021 ± 0.027	0.065 ± 0.035	0.096 ± 0.052	0.051 ± 0.061
	2041-2060	0.114 ± 0.080	0.197 ± 0.112	0.174 ± 0.147	0.295 ± 0.161
	2080-2099	0.070 ± 0.074	0.680 ± 0.413	1.769 ± 0.912	4.149 ± 1.767
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.020 ± 0.025	0.068 ± 0.036	0.088 ± 0.044	0.045 ± 0.054
	2041-2060	0.110 ± 0.080	0.212 ± 0.126	0.153 ± 0.125	0.286 ± 0.161
	2080-2099	0.071 ± 0.075	0.649 ± 0.383	1.646 ± 0.831	3.666 ± 1.604

Table 18: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr over the Middle Manawatū-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 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).



By late century (2080–2099), the signal diverges. Under low emissions (SSP1-2.6), only very slight increases are projected (well below 0.1 days/yr, extremely likely). In contrast, higher emissions scenarios (SSP2-4.5, SSP3-7.0, SSP5-8.5) project greater increases, with mean values rising to about 0.3 (SSP2-4.5), 0.6 (SSP3-7.0), and 1.4 (SSP5-8.5) days/yr. Inter-model spread, as indicated by the statistics table, grows large for higher scenarios, reflecting substantial spatial variability. Agreement across pathways drops sharply (below 20%), suggesting scenario is now the dominant influence, and results are only likely rather than very likely. Still, the overall regional signal is for a marked rise in very hot days under higher emissions, with high confidence in the direction but reduced certainty in exact magnitude.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.7 Region: Horowhenua

Area: 448.71 km²

15.7.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 50. The statistical summary of projected changes in the number of very hot days (>30°C) over

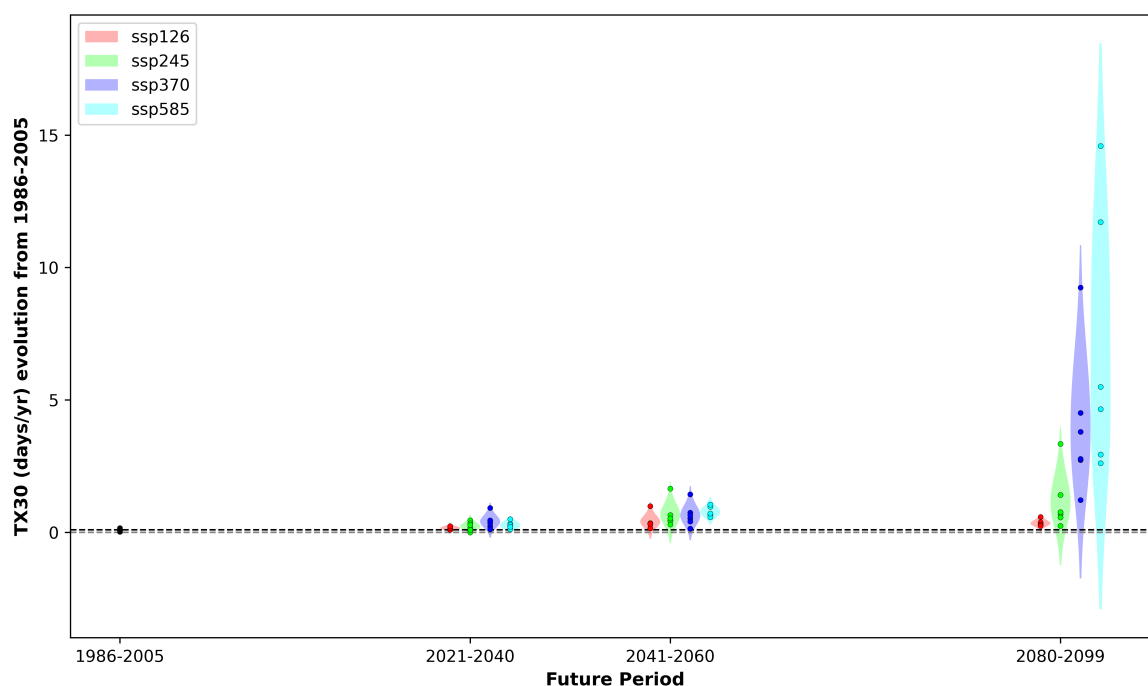


Figure 50: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Horowhenua region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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 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](#).

this region is shown in Table 19. The projections for very hot days (>30°C) in Horowhenua indicate a clear, increasing trend throughout the 21st century, with the magnitude of change strongly dependent on emissions pathway. Historically, very hot days have been rare, with a multi-model mean below 0.1 days per year during the 1986–2005 baseline. By mid-century (2041–2060), all scenarios project increases, although under the strongest mitigation (SSP1-2.6) the rise remains modest (under 0.4 days per year), while in high-emissions scenarios (SSP3-7.0, SSP5-8.5), increases reach around 0.6–0.7 days per year. For late-century (2080–2099),



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.10 ± 0.07	0.10 ± 0.07	0.10 ± 0.07	0.10 ± 0.07
	2021-2040	0.07 ± 0.06	0.13 ± 0.09	0.32 ± 0.19	0.18 ± 0.13
	2041-2060	0.31 ± 0.21	0.57 ± 0.34	0.55 ± 0.38	0.68 ± 0.42
	2080-2099	0.25 ± 0.16	1.07 ± 0.64	3.95 ± 2.21	6.90 ± 3.44
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.07 ± 0.06	0.13 ± 0.09	0.32 ± 0.20	0.18 ± 0.14
	2041-2060	0.32 ± 0.21	0.58 ± 0.35	0.56 ± 0.39	0.69 ± 0.43
	2080-2099	0.25 ± 0.16	1.10 ± 0.66	4.03 ± 2.25	7.12 ± 3.55
Multi-model minimum	Baseline	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02
	2021-2040	-0.05 ± 0.05	-0.11 ± 0.07	0.01 ± 0.06	0.01 ± 0.07
	2041-2060	0.04 ± 0.13	0.19 ± 0.19	0.04 ± 0.07	0.42 ± 0.32
	2080-2099	0.11 ± 0.09	0.14 ± 0.16	1.12 ± 0.71	2.51 ± 1.64
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.07 ± 0.05	-0.12 ± 0.06	-0.08 ± 0.09	-0.02 ± 0.05
	2041-2060	-0.11 ± 0.07	-0.12 ± 0.09	-0.06 ± 0.06	0.36 ± 0.32
	2080-2099	0.05 ± 0.04	-0.49 ± 0.18	0.08 ± 0.24	-0.09 ± 0.75
Multi-model maximum	Baseline	0.18 ± 0.12	0.18 ± 0.12	0.18 ± 0.12	0.18 ± 0.12
	2021-2040	0.19 ± 0.14	0.36 ± 0.24	0.83 ± 0.54	0.41 ± 0.29
	2041-2060	0.89 ± 0.55	1.56 ± 0.79	1.34 ± 0.87	1.04 ± 0.57
	2080-2099	0.48 ± 0.33	3.24 ± 1.66	9.14 ± 4.88	14.49 ± 6.26
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.20 ± 0.14	0.41 ± 0.25	0.77 ± 0.47	0.42 ± 0.27
	2041-2060	0.78 ± 0.47	1.36 ± 0.70	1.26 ± 0.82	1.05 ± 0.59
	2080-2099	0.48 ± 0.31	2.89 ± 1.54	8.53 ± 4.62	15.34 ± 6.89

Table 19: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



differences between scenarios become pronounced: SSP1-2.6 projects less than 0.3 days per year, while SSP5-8.5 projects nearly 7 days per year, with model maxima exceeding 14 days in extreme cases. The inter-model agreement on the direction of change is very high—virtually certain that the number of very hot days increases under all scenarios. However, the absolute magnitude under high emissions is less certain, as evidenced by widening model spreads and increased spatial variability (especially for SSP5-8.5, where standard deviation surpasses 3 days per year). Projected changes are extremely likely to be modest under strong mitigation but likely to be severe if emissions are high, reflecting low scenario agreement by century's end.

15.7.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 51. The statistical summary of projected changes in the number of very hot days (>30°C)

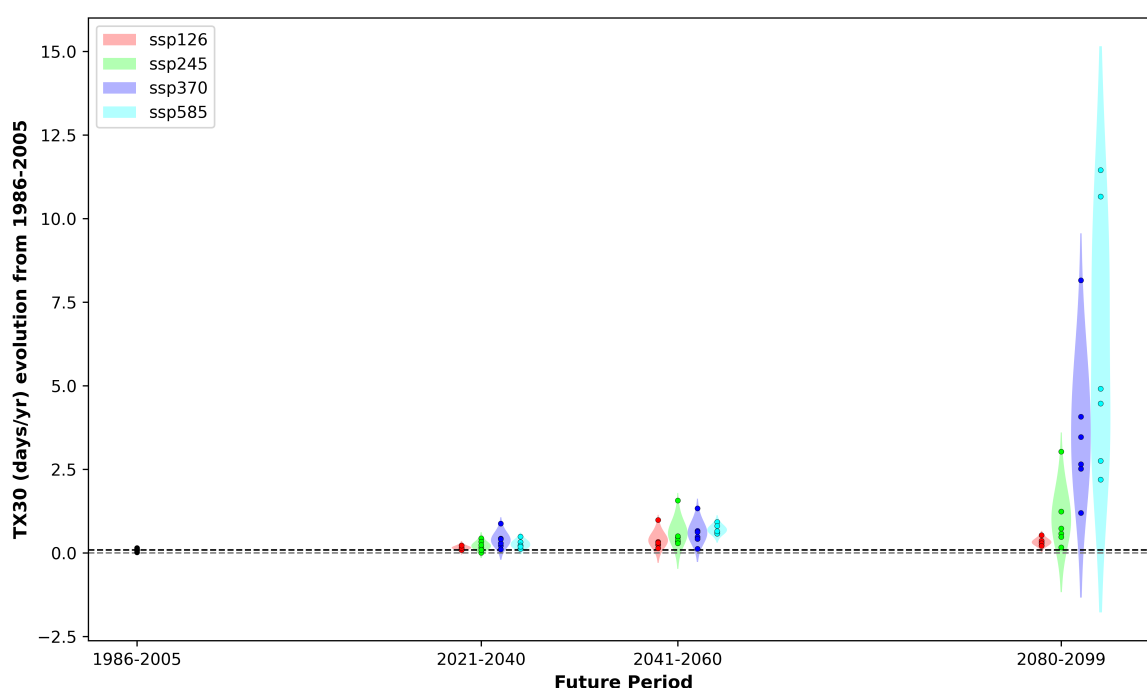


Figure 51: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Horowhenua region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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](#).

over this region is shown in Table 20. Projected changes in the annual number of very hot days (>30°C) in Horowhenua indicate a likely increasing trend through the 21st century, particularly under higher emission scenarios. For the near-term period (2021–2040), climate models show very minor changes relative to the 1986–2005 baseline, with means remaining below 0.3 days/year for all scenarios. Model agreement is moderate (around 30%) and spatial variability remains low, leading to low confidence in significant near-term change.

By mid-century (2041–2060), the multi-model means increase across all Shared Socioeconomic Pathways (SSPs), and high emissions (SSP370, SSP585) show a doubling or more in very hot days compared to the baseline, though values still remain well below 1 day/year. Inter-model agreement remains moderate, and the spatial variability increases, but there is medium confidence that hot days will become more frequent.

By late century (2080–2099), under SSP370 and SSP585, very hot days rise strongly to means of around 3.6 and 6.0 days/year respectively, with maximum values up to about 11 days. The spread between scenarios and models is substantial, resulting in low scenario agreement (about 7%), but a very likely substantial increase



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.09 ± 0.06	0.09 ± 0.06	0.09 ± 0.06	0.09 ± 0.06
	2021-2040	0.07 ± 0.06	0.12 ± 0.08	0.30 ± 0.18	0.17 ± 0.13
	2041-2060	0.29 ± 0.19	0.50 ± 0.29	0.52 ± 0.35	0.60 ± 0.37
	2080-2099	0.23 ± 0.15	0.95 ± 0.55	3.59 ± 1.97	5.98 ± 2.89
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.07 ± 0.06	0.12 ± 0.09	0.31 ± 0.19	0.18 ± 0.13
	2041-2060	0.29 ± 0.19	0.51 ± 0.30	0.53 ± 0.36	0.61 ± 0.38
	2080-2099	0.24 ± 0.15	0.97 ± 0.57	3.66 ± 2.01	6.18 ± 2.98
Multi-model minimum	Baseline	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02	0.01 ± 0.02
	2021-2040	-0.04 ± 0.03	-0.09 ± 0.06	0.01 ± 0.06	0.02 ± 0.06
	2041-2060	0.04 ± 0.12	0.16 ± 0.15	0.03 ± 0.07	0.40 ± 0.30
	2080-2099	0.10 ± 0.08	0.08 ± 0.09	1.10 ± 0.68	2.10 ± 1.38
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.06 ± 0.04	-0.11 ± 0.06	-0.08 ± 0.09	-0.03 ± 0.05
	2041-2060	-0.14 ± 0.08	-0.18 ± 0.08	-0.05 ± 0.06	0.35 ± 0.32
	2080-2099	0.04 ± 0.04	-0.49 ± 0.18	0.24 ± 0.34	0.35 ± 0.84
Multi-model maximum	Baseline	0.16 ± 0.10	0.16 ± 0.10	0.16 ± 0.10	0.16 ± 0.10
	2021-2040	0.19 ± 0.14	0.35 ± 0.23	0.79 ± 0.52	0.41 ± 0.29
	2041-2060	0.89 ± 0.55	1.48 ± 0.73	1.24 ± 0.80	0.89 ± 0.45
	2080-2099	0.46 ± 0.30	2.94 ± 1.45	8.06 ± 4.18	11.44 ± 4.69
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.19 ± 0.13	0.38 ± 0.23	0.74 ± 0.46	0.41 ± 0.27
	2041-2060	0.77 ± 0.46	1.26 ± 0.63	1.17 ± 0.75	0.89 ± 0.47
	2080-2099	0.45 ± 0.28	2.61 ± 1.35	7.55 ± 3.99	12.82 ± 5.53

Table 20: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



under higher emissions. Low emission pathways (SSP126, SSP245) show increases are likely modest. Thus, a substantial, emissions-dependent rise in extreme heat is very likely for Horowhenua by century's end, with high confidence under high emissions.

15.7.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 52. The statistical summary of projected changes in the number of very hot days (>30°C)

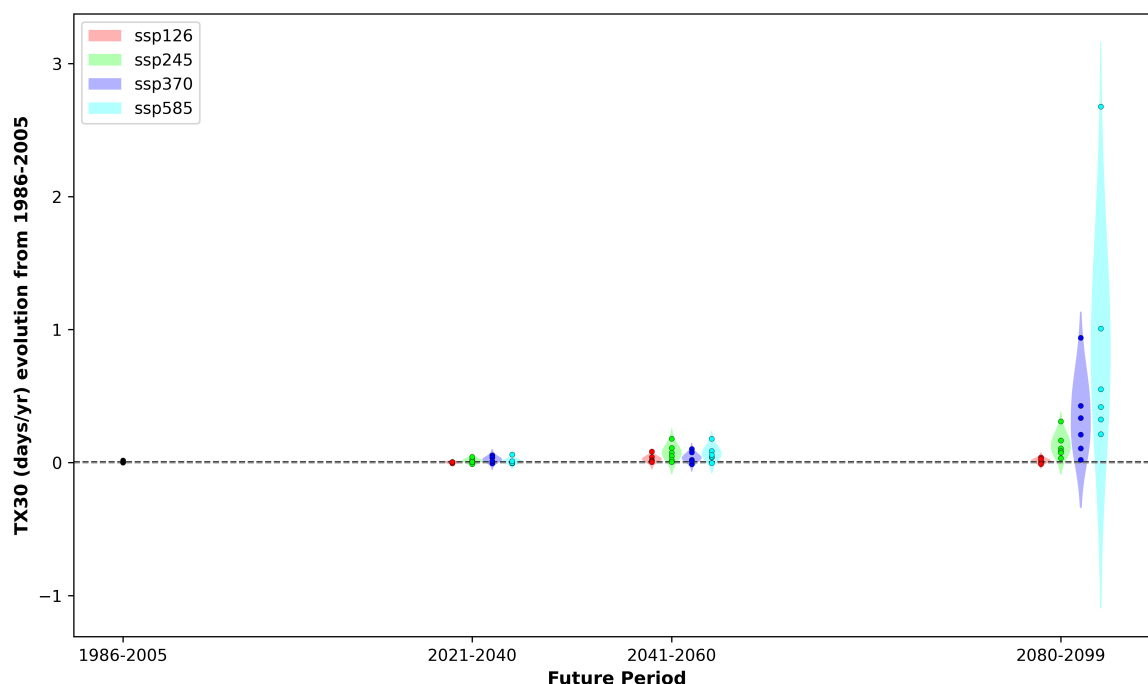


Figure 52: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Horowhenua region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

over this region is shown in Table 21. The projections for the number of very hot autumn days (>30°C) in Horowhenua indicate only minor changes through the mid-21st century across all emissions scenarios, with model ensemble means remaining close to zero in both 2021–2040 and 2041–2060. By 2080–2099, low-emissions (SSP1-2.6) scenarios continue to suggest minimal increases, whereas higher-emissions (SSP3-7.0 and notably SSP5-8.5) scenarios show a likely increase, particularly under SSP5-8.5, where the multi-model mean exceeds 0.8 days/yr above baseline. The projected increases are not spatially uniform; the standard deviation for SSP5-8.5 rises sharply to over 0.5 days/yr, reflecting considerable spatial variability across the sub-region.

Inter-model agreement is moderate in near- and mid-term periods (about 45%–47%), deteriorating substantially by late-century (about 19%), indicating low confidence in the magnitude of change under the most extreme scenarios. The signal of increased very hot days by 2080–2099 is very likely under high emissions but about as likely as not under low to moderate emissions. Model spread also increases with scenario severity, particularly evident in the broad distribution under SSP5-8.5. Overall, the climate signal is weak early in the century but becomes clearer and more substantial under high emissions in the latter part, albeit with limited agreement, so findings for late-century high-emissions scenarios should be treated with medium confidence.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.005 ± 0.006	0.005 ± 0.006	0.005 ± 0.006	0.005 ± 0.006
	2021-2040	-0.002 ± 0.004	0.009 ± 0.006	0.019 ± 0.011	0.006 ± 0.007
	2041-2060	0.022 ± 0.020	0.069 ± 0.048	0.031 ± 0.027	0.063 ± 0.044
	2080-2099	0.011 ± 0.011	0.125 ± 0.090	0.335 ± 0.221	0.861 ± 0.539
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.002 ± 0.004	0.009 ± 0.007	0.019 ± 0.011	0.007 ± 0.007
	2041-2060	0.022 ± 0.020	0.070 ± 0.049	0.032 ± 0.027	0.065 ± 0.045
	2080-2099	0.011 ± 0.012	0.127 ± 0.092	0.346 ± 0.228	0.885 ± 0.552
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.019 ± 0.024	-0.017 ± 0.024	-0.011 ± 0.021	-0.022 ± 0.025
	2041-2060	-0.011 ± 0.021	-0.011 ± 0.021	-0.017 ± 0.024	-0.008 ± 0.025
	2080-2099	-0.022 ± 0.025	0.028 ± 0.034	0.017 ± 0.037	0.203 ± 0.176
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.017 ± 0.020	-0.023 ± 0.016	-0.030 ± 0.015	-0.031 ± 0.027
	2041-2060	-0.027 ± 0.025	-0.035 ± 0.032	-0.034 ± 0.028	-0.033 ± 0.028
	2080-2099	-0.028 ± 0.020	-0.019 ± 0.028	-0.128 ± 0.091	-0.424 ± 0.182
Multi-model maximum	Baseline	0.025 ± 0.025	0.025 ± 0.025	0.025 ± 0.025	0.025 ± 0.025
	2021-2040	0.008 ± 0.019	0.039 ± 0.021	0.069 ± 0.030	0.056 ± 0.047
	2041-2060	0.078 ± 0.065	0.183 ± 0.105	0.106 ± 0.080	0.178 ± 0.107
	2080-2099	0.047 ± 0.039	0.308 ± 0.214	0.933 ± 0.639	2.672 ± 1.530
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.013 ± 0.016	0.045 ± 0.027	0.068 ± 0.033	0.046 ± 0.039
	2041-2060	0.071 ± 0.059	0.187 ± 0.110	0.102 ± 0.078	0.173 ± 0.105
	2080-2099	0.049 ± 0.038	0.292 ± 0.202	0.887 ± 0.584	2.355 ± 1.355

Table 21: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



15.8 Region: Whanganui-Manawatū Lakes

Area: 623.11 km²

15.8.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 53. The statistical summary of projected changes in the number of very hot days (>30°C) over

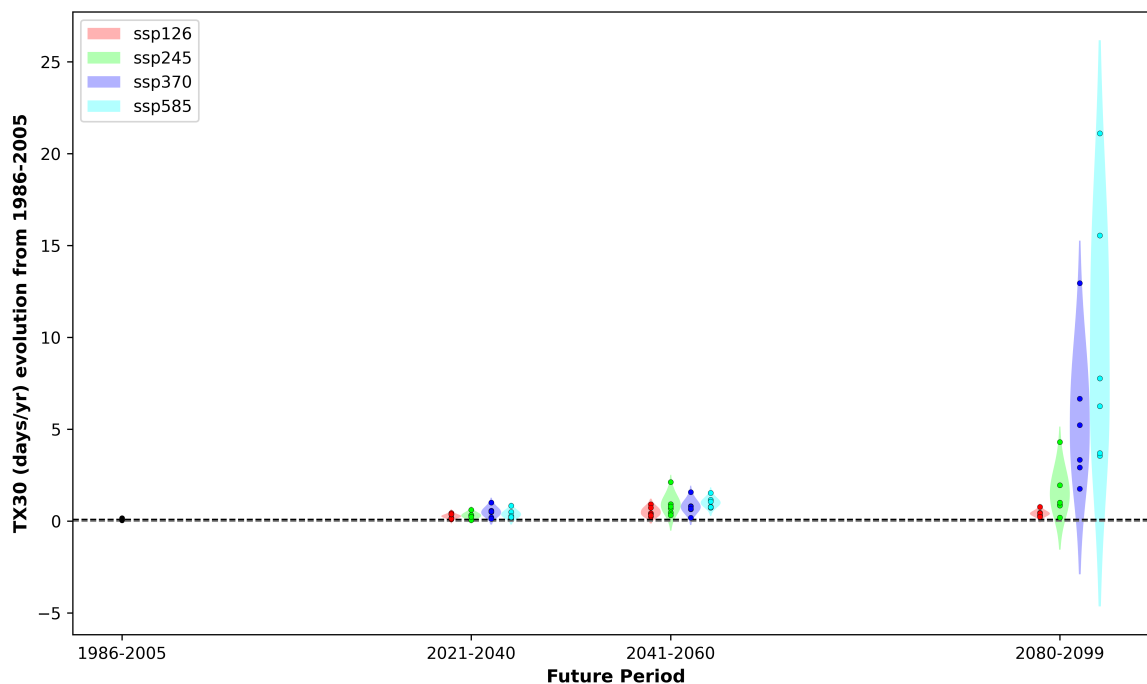


Figure 53: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Whanganui-Manawatū Lakes region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based 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](#).

this region is shown in Table 22. For Whanganui-Manawatū Lakes, projections indicate a likely increase in the number of very hot days (>30°C) through the 21st century, with the magnitude of change strongly dependent on emissions scenario. Under all SSPs, increases are modest for 2021-2040 (multi-model means <0.4 days/yr), suggesting little near-term change. By 2041-2060, upward trends remain likely but moderate, with projected means reaching around 0.4 to 0.9 days/yr depending on scenario. Differences across scenarios are minimal in the near term but become pronounced by late century. By 2080-2099, SSP126 projects only a small rise (mean ~0.3 days/yr), while SSP585 shows a much larger increase (mean ~9.6 days/yr), with SSP370 intermediate (~5.4 days/yr). Spatial variability (stdv) also grows sharply in higher-emissions scenarios and later periods, indicating more uneven changes across the region.

Inter-model spread is substantial for high-emissions scenarios at century's end, as seen in the violin plots, reflecting lower confidence in the precise magnitude but very high confidence in the direction of change. Inter-scenario agreement declines from 46% (2021-2040) to just 11% (2080-2099), further highlighting scenario dependence. Overall, it is very likely that Whanganui-Manawatū Lakes will experience more very hot days by century's end, and extremely likely that the scale will depend on global emissions.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04
	2021-2040	0.18 ± 0.07	0.22 ± 0.06	0.40 ± 0.12	0.28 ± 0.11
	2041-2060	0.41 ± 0.13	0.80 ± 0.27	0.69 ± 0.28	0.92 ± 0.25
	2080-2099	0.32 ± 0.13	1.44 ± 0.36	5.39 ± 0.94	9.57 ± 1.34
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.18 ± 0.07	0.22 ± 0.06	0.41 ± 0.12	0.29 ± 0.12
	2041-2060	0.42 ± 0.13	0.81 ± 0.27	0.70 ± 0.28	0.93 ± 0.26
	2080-2099	0.32 ± 0.13	1.48 ± 0.37	5.52 ± 0.96	9.86 ± 1.38
Multi-model minimum	Baseline	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03
	2021-2040	-0.03 ± 0.07	-0.05 ± 0.04	0.02 ± 0.06	0.05 ± 0.11
	2041-2060	0.14 ± 0.13	0.21 ± 0.13	0.09 ± 0.05	0.55 ± 0.22
	2080-2099	0.10 ± 0.08	0.11 ± 0.12	1.67 ± 0.32	3.39 ± 0.88
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.06 ± 0.06	-0.06 ± 0.06	-0.05 ± 0.06	-0.08 ± 0.10
	2041-2060	-0.01 ± 0.09	-0.12 ± 0.08	0.05 ± 0.07	0.45 ± 0.26
	2080-2099	0.02 ± 0.06	-0.59 ± 0.10	-0.28 ± 0.46	-0.45 ± 0.78
Multi-model maximum	Baseline	0.20 ± 0.08	0.20 ± 0.08	0.20 ± 0.08	0.20 ± 0.08
	2021-2040	0.40 ± 0.13	0.52 ± 0.22	0.91 ± 0.31	0.75 ± 0.20
	2041-2060	0.93 ± 0.33	2.04 ± 0.75	1.49 ± 0.62	1.46 ± 0.23
	2080-2099	0.69 ± 0.30	4.21 ± 0.93	12.86 ± 1.67	21.02 ± 1.74
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.41 ± 0.11	0.54 ± 0.18	0.92 ± 0.26	0.71 ± 0.19
	2041-2060	0.90 ± 0.23	1.84 ± 0.61	1.43 ± 0.59	1.45 ± 0.27
	2080-2099	0.66 ± 0.26	3.82 ± 0.87	12.13 ± 1.63	21.63 ± 2.27

Table 22: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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 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).



15.8.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 54. The statistical summary of projected changes in the number of very hot days (>30°C)

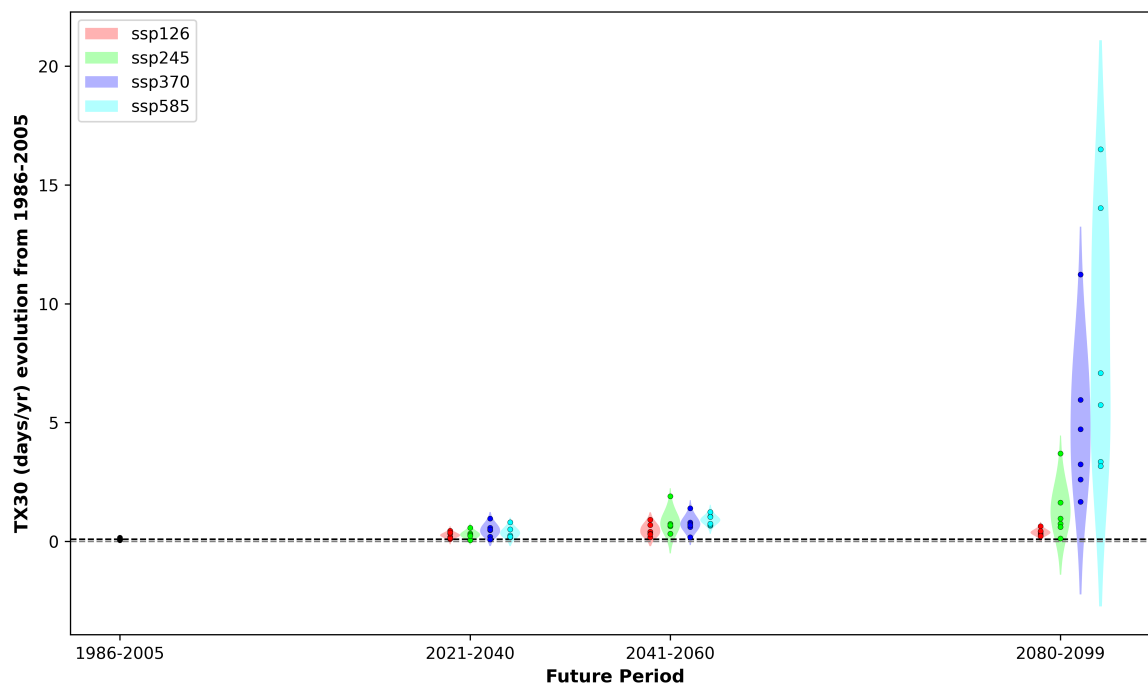


Figure 54: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Whanganui-Manawatu Lakes region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).

over this region is shown in Table 23. The figure and accompanying statistics for Whanganui-Manawatu Lakes indicate a clear, likely increase in the number of very hot days (>30°C) over the 21st century, particularly under higher emissions scenarios. Historically, such events were extremely rare, with baseline means below 0.1 days per summer. By 2021-2040, a marginal increase is evident across all scenarios, remaining under 0.4 days per year with modest inter-scenario differences (agreement: 47%). By 2041-2060, all scenarios project further increases but with greater divergence—under SSP1-2.6 the mean remains below 0.4; for SSP2-4.5, SSP3-7.0 and SSP5-8.5, it grows to around 0.7 to over 0.8 days per year, with spatial variability also increasing, especially in high emission pathways.

By 2080-2099, scenario differences are pronounced, with SSP1-2.6 stabilising below 0.3 days/year, while SSP2-4.5, and especially SSP3-7.0 and SSP5-8.5, project strong increases to 1.2, almost 5, and over 8 days/year, respectively. In these upper scenarios, maxima exceed ten very hot days in extreme model realisations, indicating that prolonged heat extremes are more than likely in worst-case emissions. Model agreement declines over time (to around 8% by century's end), signalling large uncertainty, but the most robust feature is that very hot days become substantially more frequent under higher emissions, with high confidence. Spatial variability also increases substantially, especially under SSP3-7.0 and SSP5-8.5.

15.8.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 55. The statistical summary of projected changes in the number of very hot days (>30°C)



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04	0.09 ± 0.04
	2021-2040	0.17 ± 0.07	0.20 ± 0.06	0.38 ± 0.11	0.27 ± 0.11
	2041-2060	0.38 ± 0.12	0.68 ± 0.22	0.64 ± 0.25	0.82 ± 0.22
	2080-2099	0.29 ± 0.12	1.21 ± 0.32	4.82 ± 0.84	8.23 ± 1.12
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.17 ± 0.07	0.20 ± 0.06	0.39 ± 0.12	0.28 ± 0.11
	2041-2060	0.39 ± 0.12	0.69 ± 0.22	0.65 ± 0.26	0.82 ± 0.22
	2080-2099	0.29 ± 0.12	1.24 ± 0.32	4.93 ± 0.85	8.50 ± 1.16
Multi-model minimum	Baseline	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03
	2021-2040	-0.03 ± 0.07	-0.05 ± 0.04	-0.00 ± 0.06	0.03 ± 0.09
	2041-2060	0.08 ± 0.10	0.18 ± 0.12	0.09 ± 0.05	0.50 ± 0.22
	2080-2099	0.10 ± 0.08	0.04 ± 0.09	1.58 ± 0.31	3.04 ± 0.67
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.06 ± 0.06	-0.07 ± 0.06	-0.06 ± 0.05	-0.09 ± 0.07
	2041-2060	-0.07 ± 0.07	-0.14 ± 0.08	0.07 ± 0.08	0.45 ± 0.25
	2080-2099	0.04 ± 0.06	-0.56 ± 0.12	-0.01 ± 0.47	0.30 ± 0.68
Multi-model maximum	Baseline	0.19 ± 0.07	0.19 ± 0.07	0.19 ± 0.07	0.19 ± 0.07
	2021-2040	0.40 ± 0.14	0.48 ± 0.21	0.87 ± 0.31	0.72 ± 0.19
	2041-2060	0.93 ± 0.34	1.81 ± 0.65	1.31 ± 0.57	1.21 ± 0.18
	2080-2099	0.58 ± 0.25	3.62 ± 0.86	11.14 ± 1.43	16.43 ± 1.35
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.40 ± 0.11	0.50 ± 0.17	0.89 ± 0.26	0.69 ± 0.18
	2041-2060	0.90 ± 0.23	1.61 ± 0.52	1.28 ± 0.54	1.22 ± 0.21
	2080-2099	0.56 ± 0.22	3.26 ± 0.78	10.56 ± 1.40	17.85 ± 1.94

Table 23: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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 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).

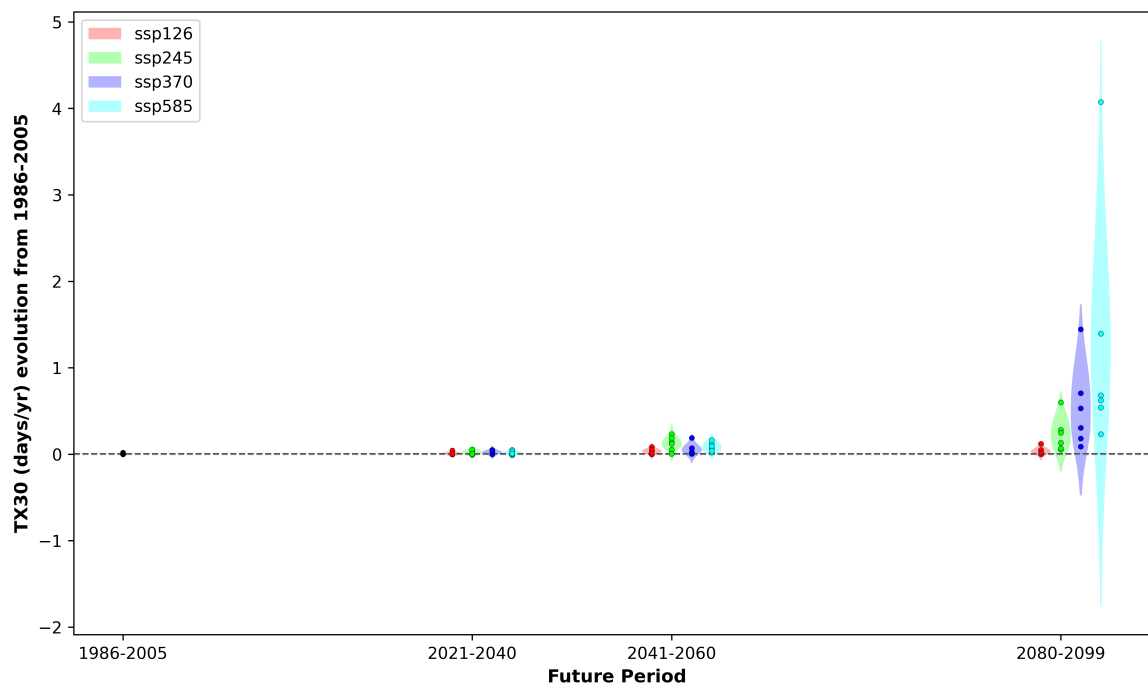


Figure 55: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Whanganui-Manawatū Lakes region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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 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](#).

over this region is shown in Table 24. Projections for the Whanganui-Manawatū Lakes region indicate a likely increase in the number of autumn days exceeding 30°C by the end of the 21st century, particularly under higher emissions scenarios. For the near future (2021–2040), changes remain minimal across all Shared Socioeconomic Pathways (SSPs), with multi-model means less than 0.02 days per year above baseline and very low spatial variability, suggesting no discernible increase and high inter-model consistency. By mid-century (2041–2060), increases become apparent under medium to high emission scenarios, especially SSP245, with multi-model means rising to 0.12 days/year and some models projecting localised larger increases. For the late 21st century (2080–2099), under SSP585 (high emissions), the mean increase exceeds 1.2 days/year, with model maxima above 4 days/year in some cases. Lower emission scenarios (SSP126) remain nearly flat, with negligible increases, reflecting a virtually certain strong dependence of projected change on emissions pathway.

Inter-model agreement weakens considerably for later periods and high emissions, as evidenced by the spread of projections and scenario agreement dropping below 22% by century's end. However, there is extremely likely (greater than 95%) model agreement on a substantial increase only under the highest emissions scenario. Spatial variability also grows, indicating emerging localised hotspots. In summary, the occurrence of autumn very hot days will remain rare, but could become a notable hazard under high emissions, with large uncertainty in magnitude.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.9 Region: Coastal Whanganui

Area: 1048.57 km²



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.005 ± 0.009	0.005 ± 0.009	0.005 ± 0.009	0.005 ± 0.009
	2021-2040	0.004 ± 0.007	0.019 ± 0.009	0.019 ± 0.009	0.015 ± 0.013
	2041-2060	0.031 ± 0.020	0.118 ± 0.051	0.048 ± 0.022	0.078 ± 0.038
	2080-2099	0.030 ± 0.015	0.225 ± 0.059	0.538 ± 0.106	1.252 ± 0.223
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.003 ± 0.007	0.020 ± 0.010	0.019 ± 0.009	0.015 ± 0.013
	2041-2060	0.031 ± 0.020	0.120 ± 0.051	0.050 ± 0.022	0.081 ± 0.038
	2080-2099	0.030 ± 0.015	0.232 ± 0.061	0.555 ± 0.108	1.286 ± 0.227
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.011 ± 0.025	-0.015 ± 0.023	-0.019 ± 0.028	-0.019 ± 0.028
	2041-2060	-0.006 ± 0.016	0.000 ± 0.000	-0.006 ± 0.016	0.011 ± 0.021
	2080-2099	-0.004 ± 0.013	0.031 ± 0.036	0.067 ± 0.043	0.228 ± 0.187
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.026 ± 0.023	-0.026 ± 0.012	-0.031 ± 0.023	-0.029 ± 0.029
	2041-2060	-0.027 ± 0.013	-0.013 ± 0.019	-0.053 ± 0.029	-0.012 ± 0.025
	2080-2099	-0.037 ± 0.015	-0.066 ± 0.033	-0.161 ± 0.034	-0.717 ± 0.123
Multi-model maximum	Baseline	0.019 ± 0.028	0.019 ± 0.028	0.019 ± 0.028	0.019 ± 0.028
	2021-2040	0.039 ± 0.021	0.063 ± 0.022	0.061 ± 0.021	0.061 ± 0.050
	2041-2060	0.091 ± 0.045	0.254 ± 0.100	0.183 ± 0.088	0.174 ± 0.066
	2080-2099	0.115 ± 0.043	0.594 ± 0.116	1.439 ± 0.260	4.069 ± 0.433
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.031 ± 0.015	0.071 ± 0.025	0.067 ± 0.026	0.060 ± 0.047
	2041-2060	0.088 ± 0.047	0.266 ± 0.101	0.164 ± 0.070	0.185 ± 0.064
	2080-2099	0.104 ± 0.042	0.572 ± 0.117	1.372 ± 0.237	3.530 ± 0.415

Table 24: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



15.9.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 56. The statistical summary of projected changes in the number of very hot days (>30°C) over

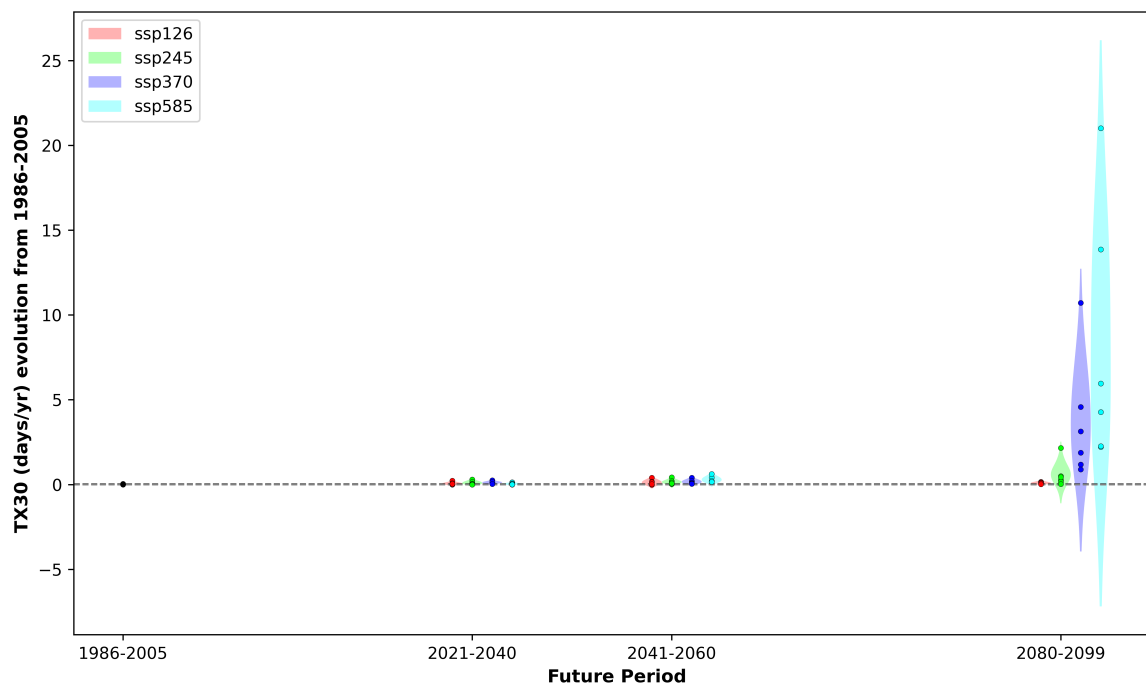


Figure 56: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Coastal Whanganui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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](#).

this region is shown in Table 25. Projected changes in the annual number of very hot days (>30°C) in Coastal Whanganui show a clear signal of increasing frequency by the end of the 21st century, especially under higher emissions scenarios (SSP370, SSP585). For the historical baseline, the region experiences essentially no very hot days per year. Through mid-century, all scenarios show only negligible increases, with multi-model means remaining below 0.3 days/yr, and low spatial variability. This pattern indicates high across-model consistency and high confidence in minimal near-term change.

By 2080–2099, however, a pronounced divergence emerges. Under SSP126, very hot days remain rare, with a mean still below 0.1 days/yr. Under SSP245, the mean rises above 0.5 days/yr, while under SSP370 and SSP585, mean values reach about 4 and 8 days/yr, respectively, with maximum local values far higher. The increases under the higher scenarios are very likely, given both the magnitude of the multi-model ensemble mean change and the visual consistency in model outputs. However, across-scenario agreement decreases notably (about 20% in late century), and spatial variability rises sharply, especially for SSP585, reflecting both inter-model and geographic differences. These results provide high confidence that substantial increases in very hot days are likely only under higher emissions futures.

15.9.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 57. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 26. Projections for the Coastal Whanganui sub-region indicate a likely increase in



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02
	2021-2040	0.04 ± 0.02	0.08 ± 0.05	0.11 ± 0.08	0.02 ± 0.03
	2041-2060	0.11 ± 0.08	0.13 ± 0.12	0.15 ± 0.11	0.28 ± 0.18
	2080-2099	0.08 ± 0.06	0.58 ± 0.34	3.71 ± 1.83	8.24 ± 3.38
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.04 ± 0.03	0.08 ± 0.05	0.11 ± 0.08	0.02 ± 0.03
	2041-2060	0.11 ± 0.08	0.13 ± 0.12	0.16 ± 0.11	0.28 ± 0.18
	2080-2099	0.08 ± 0.06	0.59 ± 0.35	3.82 ± 1.87	8.54 ± 3.50
Multi-model minimum	Baseline	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	2021-2040	-0.04 ± 0.03	-0.04 ± 0.04	0.01 ± 0.02	-0.05 ± 0.04
	2041-2060	-0.06 ± 0.04	-0.01 ± 0.04	0.01 ± 0.05	0.10 ± 0.11
	2080-2099	-0.01 ± 0.05	0.00 ± 0.04	0.76 ± 0.45	2.02 ± 1.36
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.03	-0.10 ± 0.04	-0.01 ± 0.03	-0.06 ± 0.04
	2041-2060	-0.13 ± 0.06	-0.09 ± 0.10	-0.05 ± 0.05	-0.00 ± 0.07
	2080-2099	-0.03 ± 0.04	-0.51 ± 0.27	-1.39 ± 0.40	-2.44 ± 0.72
Multi-model maximum	Baseline	0.06 ± 0.04	0.06 ± 0.04	0.06 ± 0.04	0.06 ± 0.04
	2021-2040	0.21 ± 0.09	0.29 ± 0.14	0.24 ± 0.17	0.12 ± 0.10
	2041-2060	0.39 ± 0.20	0.41 ± 0.35	0.39 ± 0.24	0.62 ± 0.39
	2080-2099	0.18 ± 0.11	2.14 ± 1.20	10.69 ± 4.78	20.99 ± 6.20
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.19 ± 0.08	0.28 ± 0.15	0.24 ± 0.17	0.12 ± 0.09
	2041-2060	0.38 ± 0.22	0.39 ± 0.32	0.39 ± 0.24	0.60 ± 0.34
	2080-2099	0.20 ± 0.12	1.80 ± 1.02	9.74 ± 4.40	21.06 ± 7.17

Table 25: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02	0.02 ± 0.02
	2021-2040	0.04 ± 0.02	0.07 ± 0.05	0.11 ± 0.08	0.02 ± 0.03
	2041-2060	0.10 ± 0.07	0.12 ± 0.11	0.15 ± 0.10	0.26 ± 0.16
	2080-2099	0.07 ± 0.06	0.53 ± 0.31	3.40 ± 1.66	7.31 ± 2.98
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.04 ± 0.03	0.08 ± 0.05	0.11 ± 0.08	0.02 ± 0.03
	2041-2060	0.10 ± 0.07	0.13 ± 0.11	0.15 ± 0.10	0.26 ± 0.17
	2080-2099	0.08 ± 0.06	0.54 ± 0.32	3.50 ± 1.70	7.58 ± 3.10
Multi-model minimum	Baseline	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	2021-2040	-0.04 ± 0.03	-0.04 ± 0.04	0.00 ± 0.02	-0.05 ± 0.04
	2041-2060	-0.06 ± 0.04	-0.02 ± 0.04	0.01 ± 0.05	0.10 ± 0.11
	2080-2099	-0.01 ± 0.05	-0.03 ± 0.04	0.69 ± 0.43	1.82 ± 1.18
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.03	-0.10 ± 0.04	-0.01 ± 0.03	-0.06 ± 0.04
	2041-2060	-0.13 ± 0.06	-0.10 ± 0.10	-0.05 ± 0.05	0.02 ± 0.09
	2080-2099	-0.03 ± 0.03	-0.48 ± 0.26	-1.21 ± 0.33	-1.73 ± 0.75
Multi-model maximum	Baseline	0.06 ± 0.04	0.06 ± 0.04	0.06 ± 0.04	0.06 ± 0.04
	2021-2040	0.21 ± 0.09	0.28 ± 0.13	0.23 ± 0.16	0.12 ± 0.10
	2041-2060	0.39 ± 0.21	0.41 ± 0.34	0.37 ± 0.22	0.54 ± 0.30
	2080-2099	0.18 ± 0.11	1.98 ± 1.11	9.64 ± 4.25	17.52 ± 5.02
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.19 ± 0.08	0.28 ± 0.14	0.24 ± 0.17	0.12 ± 0.09
	2041-2060	0.37 ± 0.21	0.37 ± 0.30	0.37 ± 0.22	0.54 ± 0.27
	2080-2099	0.20 ± 0.11	1.66 ± 0.94	8.86 ± 3.93	18.21 ± 6.22

Table 26: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

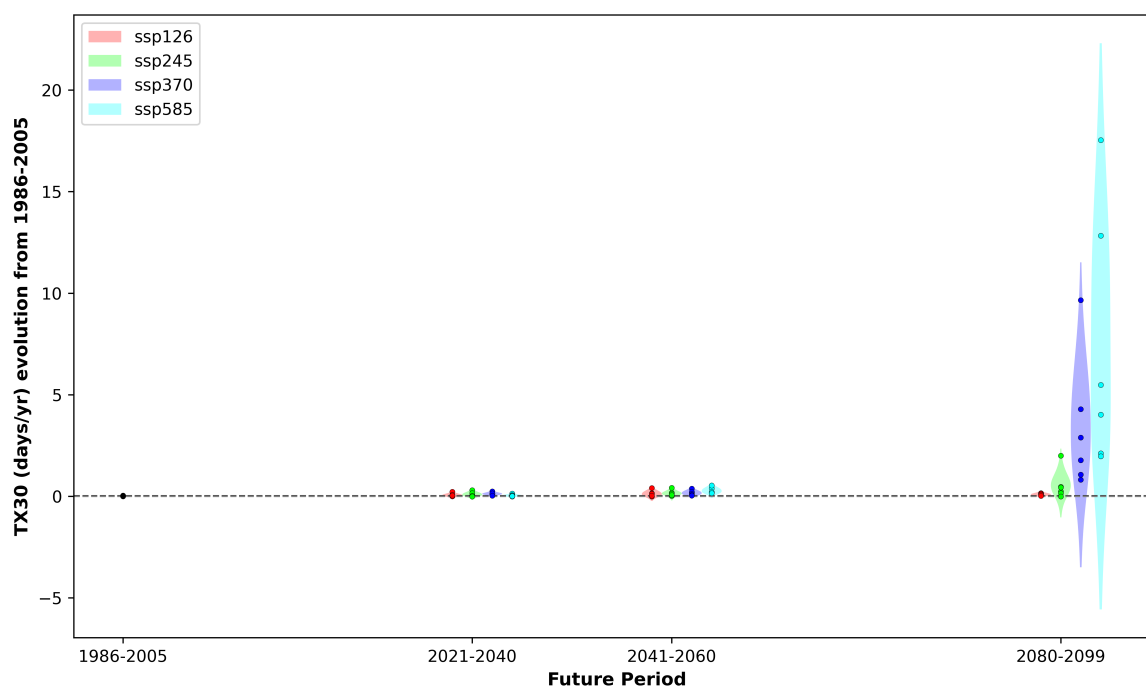


Figure 57: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Coastal Whanganui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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](#).

the annual number of very hot summer days (>30°C) by the late 21st century, with the magnitude of change strongly dependent on emissions scenario. For the near- and mid-term periods (2021–2060), the projected increases are modest under all scenarios, remaining close to the baseline and with multi-model means below 0.3 days/yr. Across all scenarios for this timeframe, the increase is minor and inter-model spread is low, supporting medium confidence and a very likely outcome that very hot days will remain rare through mid-century.

However, by 2080–2099, strong divergence emerges between scenarios. Under low emissions (SSP1-2.6), occurrences remain low, highly likely below 0.2 days/yr. In contrast, under high emissions (SSP3-7.0 and SSP5-8.5), substantial increases are projected, with multi-model means reaching approximately 3.4 and 7.3 days/yr respectively, and maximum model estimates exceeding 9 and 17 days/yr. These larger increases show high inter-model variability, particularly under SSP5-8.5, indicating lower confidence in the precise magnitude but high confidence in the direction of change. Inter-scenario agreement across models is low for the end of century (18%), reflecting scenario-driven spread. It is virtually certain that higher emissions will result in many more very hot days in summer for Coastal Whanganui.

15.9.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 58. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 27. Projections for the number of very hot days (>30°C) in Coastal Whanganui during autumn suggest that such events have been virtually absent historically and are expected to remain scarce through mid-century under all emissions scenarios. By 2080-2099, however, a strong divergence emerges between scenarios. Under SSP1-2.6 (low emissions), changes remain minimal, with almost no increase in extremely hot days, and similarly low spatial variability. In contrast, higher emissions scenarios (SSP2-4.5, SSP3-7.0, SSP5-8.5) show a likely increase in the frequency of very hot days, with the multi-model mean rise



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.002	0.005 ± 0.005	0.003 ± 0.005	0.000 ± 0.000
	2041-2060	0.007 ± 0.007	0.006 ± 0.011	0.004 ± 0.007	0.008 ± 0.010
	2080-2099	0.003 ± 0.004	0.041 ± 0.038	0.272 ± 0.155	0.798 ± 0.389
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.000 ± 0.002	0.005 ± 0.005	0.003 ± 0.005	0.000 ± 0.000
	2041-2060	0.007 ± 0.008	0.006 ± 0.012	0.004 ± 0.007	0.008 ± 0.010
	2080-2099	0.003 ± 0.004	0.042 ± 0.039	0.280 ± 0.160	0.823 ± 0.399
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.047 ± 0.042	0.086 ± 0.108
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.001 ± 0.005	-0.010 ± 0.010	-0.008 ± 0.013	0.000 ± 0.000
	2041-2060	-0.013 ± 0.015	-0.007 ± 0.011	-0.008 ± 0.011	-0.009 ± 0.010
	2080-2099	-0.007 ± 0.010	-0.049 ± 0.033	-0.156 ± 0.072	-0.660 ± 0.188
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.002 ± 0.010	0.027 ± 0.025	0.019 ± 0.029	0.000 ± 0.000
	2041-2060	0.034 ± 0.040	0.022 ± 0.034	0.022 ± 0.031	0.027 ± 0.029
	2080-2099	0.017 ± 0.024	0.167 ± 0.131	0.875 ± 0.470	2.892 ± 1.179
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.002 ± 0.008	0.022 ± 0.021	0.015 ± 0.022	0.000 ± 0.000
	2041-2060	0.029 ± 0.033	0.020 ± 0.034	0.018 ± 0.026	0.028 ± 0.031
	2080-2099	0.012 ± 0.017	0.142 ± 0.112	0.769 ± 0.413	2.478 ± 1.032

Table 27: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

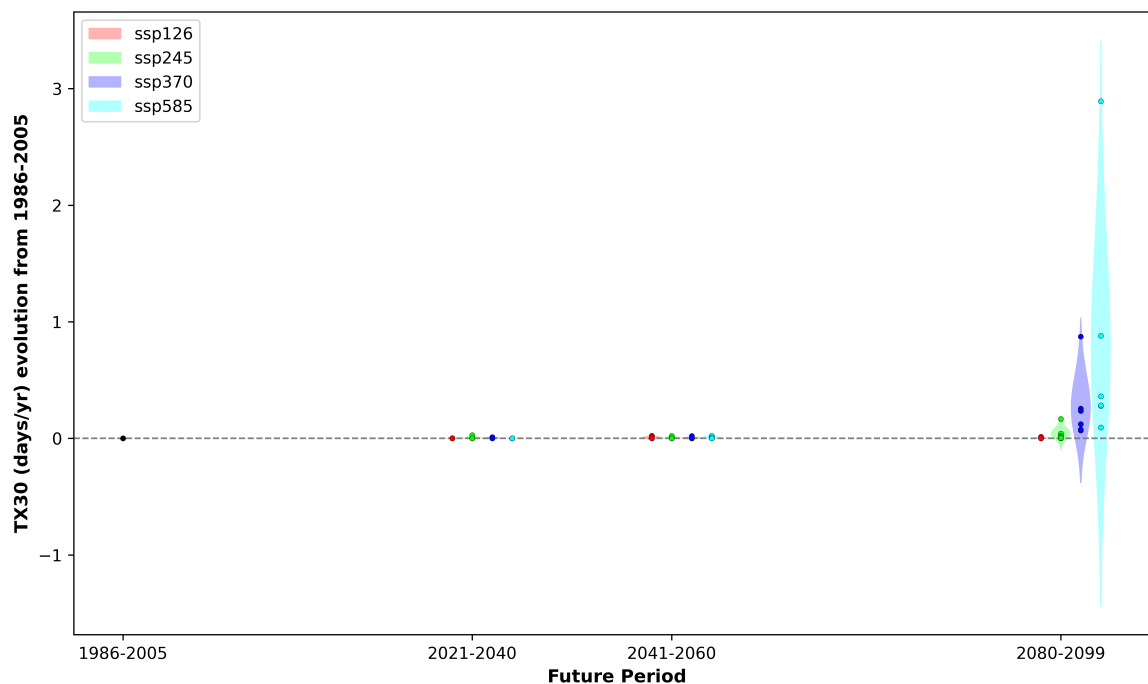


Figure 58: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Coastal Whanganui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

reaching around 0.8 days per year under SSP5-8.5. Inter-model and scenario agreement is high early in the century but becomes low by late century (agreement falls below 27%), reflecting wide variability in projected outcomes. This is corroborated by a substantial increase in spatial variability under higher emissions scenarios, as indicated by the rise in regional standard deviation and the spread of modelled values. The results indicate that very hot days may remain rare for most pathways, but under high emissions, a notable increase is likely, and in some locations and models, extremely hot days could approach or exceed 2–3 days per year by century's end. Confidence in these late-century projections is medium due to the low inter-model agreement.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.

15.10 Region: Turakina

Area: 1237.15 km²

15.10.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 59. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 28. Projected changes in the number of very hot days (>30°C) in Turakina indicate substantial increases by late century, particularly under high emissions scenarios. Currently, very hot days are virtually absent (mean near zero days per year), and changes remain negligible through mid-century across all pathways. From 2021 to 2060, multi-model means remain below 0.5 days/yr for all scenarios, with very small spatial variability, indicating high confidence in the lack of early-century change. By 2080-2099, however, strong divergence emerges: under SSP126 the mean remains near current levels (~0.1 days/yr), whereas under SSP245, SSP370, and SSP585, multi-model means increase to just under 1, 5, and 10 days/yr



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03
	2021-2040	0.09 ± 0.05	0.09 ± 0.07	0.16 ± 0.14	0.08 ± 0.06
	2041-2060	0.19 ± 0.11	0.30 ± 0.24	0.32 ± 0.24	0.43 ± 0.29
	2080-2099	0.15 ± 0.12	0.92 ± 0.57	4.82 ± 2.32	9.99 ± 3.82
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.10 ± 0.05	0.09 ± 0.07	0.17 ± 0.14	0.08 ± 0.06
	2041-2060	0.20 ± 0.12	0.31 ± 0.24	0.33 ± 0.24	0.43 ± 0.29
	2080-2099	0.15 ± 0.12	0.94 ± 0.58	4.94 ± 2.37	10.33 ± 3.94
Multi-model minimum	Baseline	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
	2021-2040	-0.04 ± 0.04	-0.05 ± 0.04	-0.00 ± 0.02	-0.08 ± 0.03
	2041-2060	-0.05 ± 0.05	0.02 ± 0.08	0.10 ± 0.10	0.16 ± 0.22
	2080-2099	0.01 ± 0.04	0.08 ± 0.11	1.36 ± 0.75	3.17 ± 1.85
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.03	-0.12 ± 0.06	-0.04 ± 0.03	-0.10 ± 0.04
	2041-2060	-0.21 ± 0.08	-0.20 ± 0.12	-0.03 ± 0.07	0.06 ± 0.21
	2080-2099	-0.03 ± 0.05	-0.80 ± 0.44	-1.15 ± 0.30	-1.63 ± 1.19
Multi-model maximum	Baseline	0.10 ± 0.03	0.10 ± 0.03	0.10 ± 0.03	0.10 ± 0.03
	2021-2040	0.29 ± 0.09	0.36 ± 0.23	0.40 ± 0.29	0.27 ± 0.15
	2041-2060	0.72 ± 0.32	0.99 ± 0.69	0.79 ± 0.60	0.87 ± 0.40
	2080-2099	0.36 ± 0.31	3.43 ± 2.01	13.15 ± 5.58	23.28 ± 6.46
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.28 ± 0.10	0.33 ± 0.19	0.40 ± 0.29	0.27 ± 0.14
	2041-2060	0.65 ± 0.30	0.87 ± 0.58	0.72 ± 0.52	0.86 ± 0.42
	2080-2099	0.35 ± 0.28	2.86 ± 1.68	11.87 ± 5.15	23.98 ± 7.34

Table 28: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

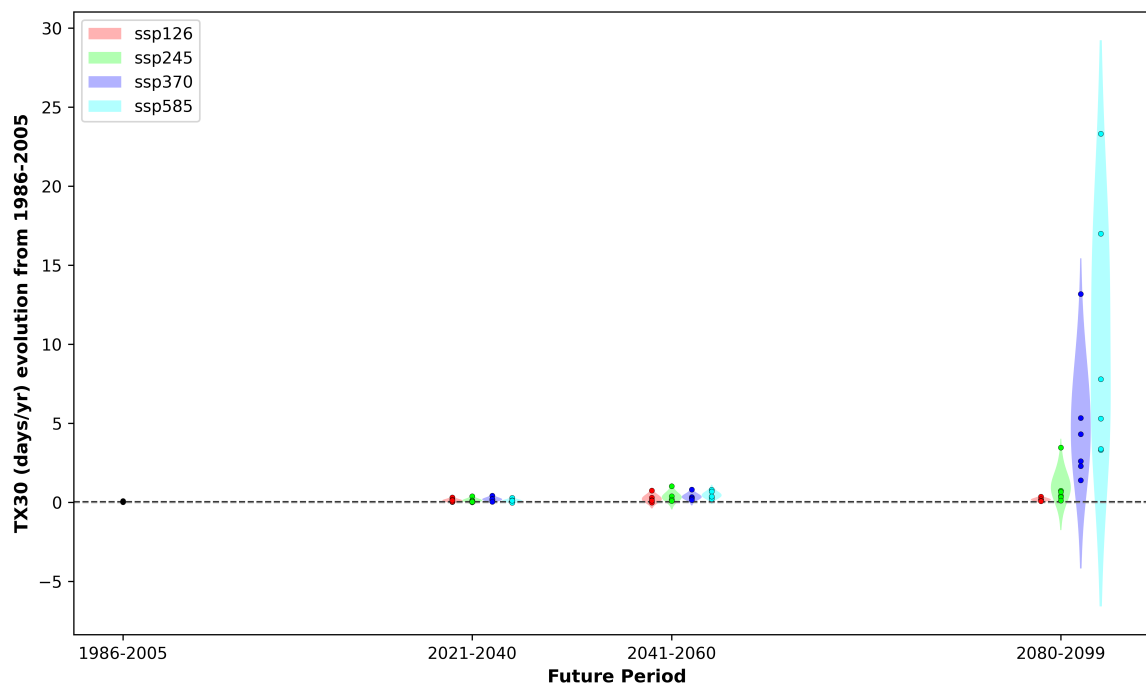


Figure 59: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Turakina region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).

respectively. Maximum model projections for SSP370 and SSP585 exceed 13 and 23 days/yr respectively. This spread is mirrored in increasing inter-model and spatial variability, especially for SSP370 and SSP585, but the direction of change is uniformly positive, supporting high confidence in increased frequency of very hot days under stronger warming.

Agreement across scenarios is strong early in the century but drops sharply by 2080-2099. It is very likely that a substantive increase in very hot days will occur in Turakina under high emissions scenarios, with extremely likely increases in spatial variability and inter-model disagreement alongside larger mean changes.

15.10.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 60. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 29. Projections for Turakina indicate a strong increase in the number of very hot days (>30°C) towards the end of the century, especially under higher emissions scenarios. For the near and mid-term (2021–2060), changes are minimal, with multi-model means remaining well below one day per year across all scenarios, and differences between SSPs are very small. However, by 2080–2099, a significant divergence emerges: under SSP126 very hot days remain rare, with an average well below one day per year. In contrast, SSP245 projects a moderate increase to just under one day per year on average, while for SSP370 and especially SSP585, large increases are projected—multi-model means rise to over 4 and nearly 9 days per year, respectively. The figure and table jointly suggest this emergence is limited to the highest emissions trajectories.

Model agreement is very likely in early periods, with consistent signals across scenarios, but agreement declines markedly for 2080–2099 (percentage agreement falls to 14%), reflecting growing scenario spread. Inter-model spread also increases sharply at century's end, as shown in the widening violins and rising spatial standard deviations (e.g. >3 days/yr for SSP585). It is virtually certain that the magnitude of change is strongly



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03
	2021-2040	0.09 ± 0.05	0.08 ± 0.06	0.15 ± 0.13	0.08 ± 0.06
	2041-2060	0.18 ± 0.10	0.27 ± 0.21	0.31 ± 0.23	0.40 ± 0.26
	2080-2099	0.14 ± 0.12	0.84 ± 0.50	4.43 ± 2.06	8.98 ± 3.28
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.09 ± 0.05	0.09 ± 0.06	0.15 ± 0.13	0.08 ± 0.06
	2041-2060	0.19 ± 0.10	0.28 ± 0.21	0.31 ± 0.23	0.40 ± 0.26
	2080-2099	0.15 ± 0.12	0.87 ± 0.51	4.54 ± 2.11	9.30 ± 3.39
Multi-model minimum	Baseline	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02	0.00 ± 0.02
	2021-2040	-0.04 ± 0.04	-0.05 ± 0.04	-0.01 ± 0.03	-0.08 ± 0.03
	2041-2060	-0.05 ± 0.04	0.02 ± 0.07	0.10 ± 0.10	0.15 ± 0.22
	2080-2099	0.01 ± 0.04	0.03 ± 0.06	1.28 ± 0.72	2.92 ± 1.57
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.09 ± 0.03	-0.12 ± 0.06	-0.05 ± 0.04	-0.10 ± 0.04
	2041-2060	-0.22 ± 0.08	-0.21 ± 0.13	-0.02 ± 0.07	0.05 ± 0.22
	2080-2099	-0.03 ± 0.05	-0.79 ± 0.42	-0.92 ± 0.28	-1.05 ± 1.22
Multi-model maximum	Baseline	0.10 ± 0.03	0.10 ± 0.03	0.10 ± 0.03	0.10 ± 0.03
	2021-2040	0.29 ± 0.09	0.36 ± 0.22	0.38 ± 0.27	0.27 ± 0.15
	2041-2060	0.71 ± 0.32	0.94 ± 0.65	0.75 ± 0.57	0.81 ± 0.35
	2080-2099	0.36 ± 0.31	3.22 ± 1.81	11.86 ± 4.76	19.80 ± 5.06
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.28 ± 0.10	0.32 ± 0.18	0.38 ± 0.26	0.27 ± 0.14
	2041-2060	0.63 ± 0.28	0.82 ± 0.54	0.68 ± 0.50	0.79 ± 0.36
	2080-2099	0.34 ± 0.27	2.68 ± 1.51	10.75 ± 4.44	21.10 ± 6.10

Table 29: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

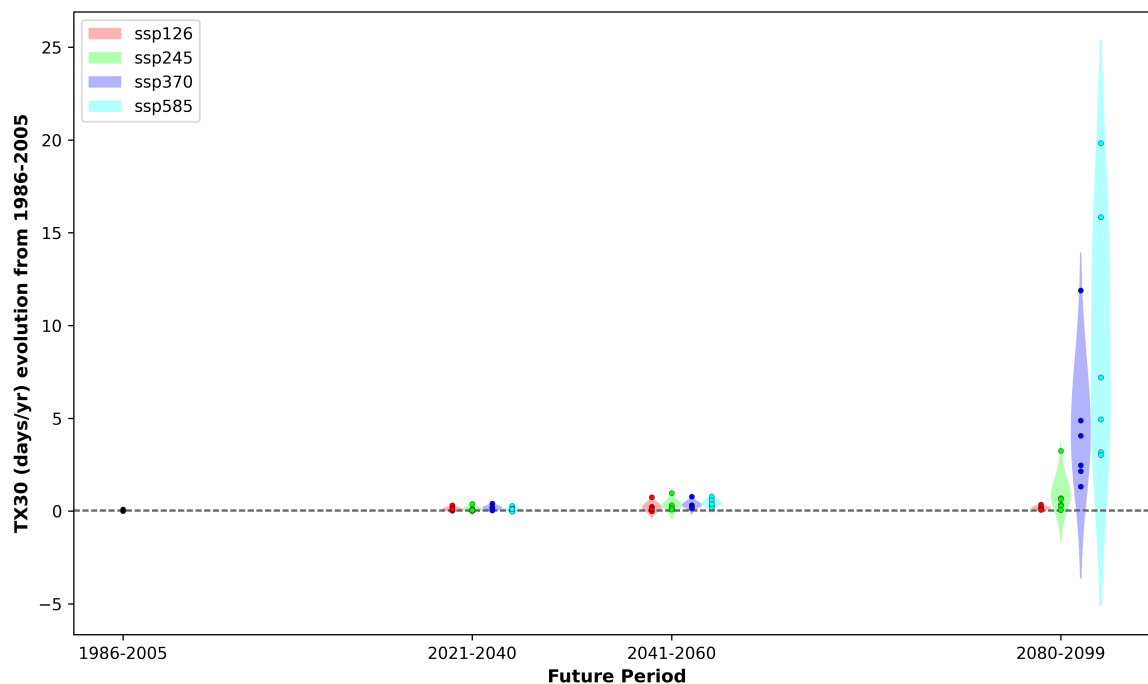


Figure 60: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Turakina region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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-dependent, increasing the likelihood of frequent very hot days in high emission futures.

15.10.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 61. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 30. Climate projections for Turakina indicate that, under all SSP scenarios, the number of very hot days (>30°C) during autumn remains negligible through mid-century, with multi-model means well below 0.1 days per year until the 2080–2099 period. By late century, a strong scenario dependence emerges. Under SSP126, the increase remains minimal, with virtually no change (mean ≈ 0.004 days/yr). For intermediate (SSP245) and medium-high (SSP370) pathways, modest growth is projected (means of ~ 0.07 and ~ 0.33 days/yr, respectively), while high emissions (SSP585) show a more substantial rise to nearly 0.9 days/yr. This equates to less than one very hot day per year even in the highest emission pathway.

Inter-model spread also increases sharply by late century, especially in SSP585, with substantial spatial variability (standard deviation >0.5 days/yr). Minimum, median, and maximum values further underline this spread. Agreement across scenarios on sign and magnitude of change is moderate to low, dropping to 27% in the late-century period, indicating low confidence in precise quantitative outcomes for extreme heat event frequency, particularly under higher forcing.

Overall, it is very likely Turakina will experience a modest increase in autumn very hot days only under the highest emission scenario, with low confidence in the magnitude of late-century change due to large inter-model and scenario spread.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.005 ± 0.005	0.006 ± 0.007	0.014 ± 0.013	0.000 ± 0.001
	2041-2060	0.012 ± 0.015	0.022 ± 0.026	0.008 ± 0.010	0.014 ± 0.021
	2080-2099	0.004 ± 0.004	0.071 ± 0.081	0.335 ± 0.242	0.868 ± 0.535
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.005 ± 0.005	0.006 ± 0.007	0.014 ± 0.013	0.000 ± 0.001
	2041-2060	0.012 ± 0.016	0.023 ± 0.027	0.009 ± 0.010	0.015 ± 0.021
	2080-2099	0.004 ± 0.004	0.072 ± 0.083	0.346 ± 0.249	0.893 ± 0.548
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.001 ± 0.007	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.036 ± 0.053	0.131 ± 0.142
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.012 ± 0.011	-0.010 ± 0.010	-0.032 ± 0.026	-0.000 ± 0.003
	2041-2060	-0.022 ± 0.018	-0.018 ± 0.011	-0.013 ± 0.013	-0.015 ± 0.017
	2080-2099	-0.009 ± 0.010	-0.038 ± 0.042	-0.197 ± 0.104	-0.530 ± 0.172
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.028 ± 0.027	0.027 ± 0.027	0.075 ± 0.061	0.001 ± 0.007
	2041-2060	0.059 ± 0.060	0.069 ± 0.057	0.036 ± 0.039	0.049 ± 0.056
	2080-2099	0.023 ± 0.025	0.220 ± 0.248	1.066 ± 0.721	2.864 ± 1.427
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.021 ± 0.020	0.023 ± 0.023	0.057 ± 0.046	0.001 ± 0.005
	2041-2060	0.049 ± 0.051	0.069 ± 0.062	0.032 ± 0.035	0.048 ± 0.057
	2080-2099	0.016 ± 0.018	0.192 ± 0.218	0.962 ± 0.636	2.485 ± 1.296

Table 30: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

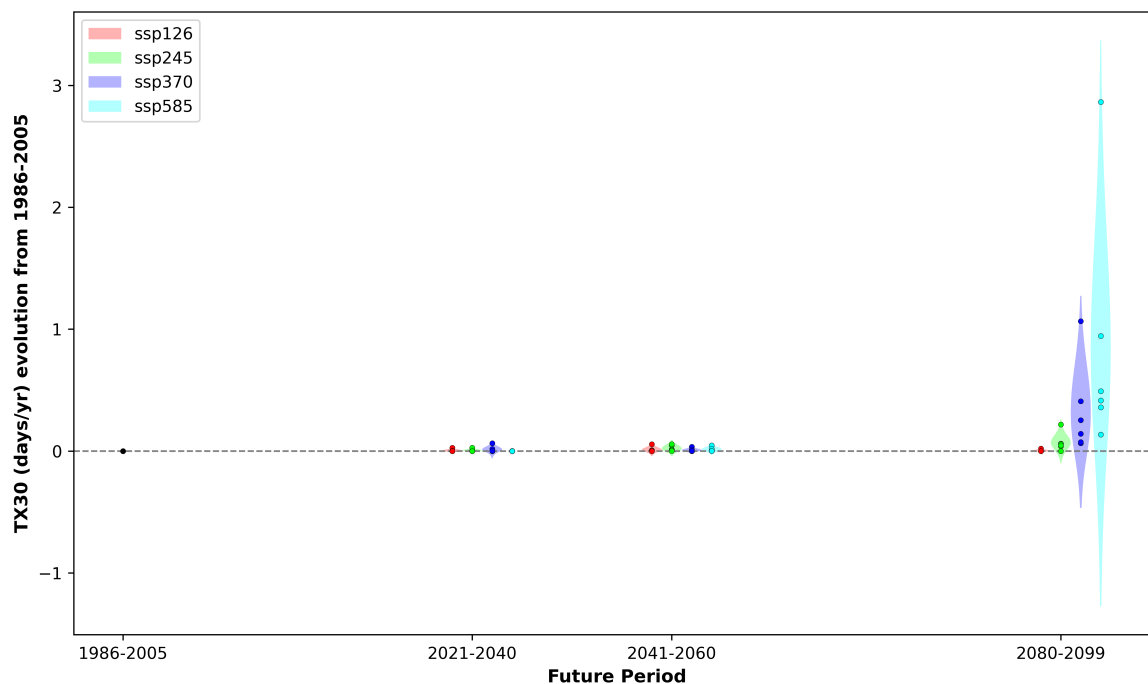


Figure 61: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Turakina region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

15.11 Region: Puketoi ki Tai

Area: 966.64 km²

15.11.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 62. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 31. The projected number of very hot days (>30°C) per year in Puketoi ki Tai shows a marked increase through the 21st century, with the magnitude and rate of change dependent on the emissions pathway. Present-day conditions rarely exceed 0.1 days per year. By mid-century (2041–2060), all scenarios project a likely rise, but notably under SSP3-7.0 and SSP5-8.5, the mean reaches about 0.9 to 1.3 days per year, compared to less than 1 for lower scenarios, with moderate spatial variability. By late century (2080–2099), the increase under high-emissions scenarios becomes substantial: under SSP5-8.5, the multi-model mean exceeds 11 days per year, and even the low scenario (SSP1-2.6) remains well above baseline. The range of projected values and inter-model spread both increase markedly by century's end, especially for high emissions, as seen in wider violin plots and rising spatial standard deviations. Scenario agreement diminishes through time, dropping to just 7% by 2080–2099, indicating low confidence in the precise magnitude but high confidence in the direction of change. It is virtually certain that very hot days will increase, and extremely likely that the largest changes will occur under high-emissions futures. Risk management should therefore plan for substantial heat extremes, especially if emissions are not curtailed.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.14 ± 0.10	0.14 ± 0.10	0.14 ± 0.10	0.14 ± 0.10
	2021-2040	0.33 ± 0.16	0.46 ± 0.23	0.50 ± 0.26	0.31 ± 0.18
	2041-2060	0.66 ± 0.38	0.96 ± 0.43	0.90 ± 0.50	1.33 ± 0.74
	2080-2099	0.57 ± 0.33	2.05 ± 0.98	6.40 ± 2.34	11.10 ± 3.66
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.34 ± 0.16	0.47 ± 0.24	0.51 ± 0.26	0.32 ± 0.18
	2041-2060	0.69 ± 0.39	0.98 ± 0.44	0.91 ± 0.50	1.35 ± 0.74
	2080-2099	0.58 ± 0.34	2.10 ± 1.01	6.52 ± 2.38	11.40 ± 3.72
Multi-model minimum	Baseline	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04	0.03 ± 0.04
	2021-2040	0.04 ± 0.12	0.07 ± 0.14	0.10 ± 0.11	0.01 ± 0.16
	2041-2060	0.07 ± 0.19	0.11 ± 0.11	0.43 ± 0.29	0.49 ± 0.30
	2080-2099	0.07 ± 0.12	0.30 ± 0.23	2.36 ± 1.10	4.35 ± 1.98
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.09 ± 0.07	0.01 ± 0.09	-0.02 ± 0.09	-0.01 ± 0.14
	2041-2060	-0.32 ± 0.12	-0.52 ± 0.23	0.20 ± 0.20	0.49 ± 0.40
	2080-2099	-0.09 ± 0.17	-0.56 ± 0.27	-0.02 ± 0.84	0.72 ± 1.70
Multi-model maximum	Baseline	0.27 ± 0.16	0.27 ± 0.16	0.27 ± 0.16	0.27 ± 0.16
	2021-2040	0.81 ± 0.33	0.98 ± 0.49	1.04 ± 0.42	0.62 ± 0.27
	2041-2060	1.91 ± 0.86	3.04 ± 1.20	1.79 ± 0.95	2.13 ± 1.02
	2080-2099	1.38 ± 0.75	5.55 ± 2.39	15.47 ± 4.75	22.86 ± 5.81
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.82 ± 0.31	0.97 ± 0.45	1.10 ± 0.49	0.67 ± 0.25
	2041-2060	1.84 ± 0.82	2.62 ± 1.03	1.71 ± 0.90	2.31 ± 1.15
	2080-2099	1.31 ± 0.70	5.10 ± 2.28	13.90 ± 4.38	23.57 ± 6.22

Table 31: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

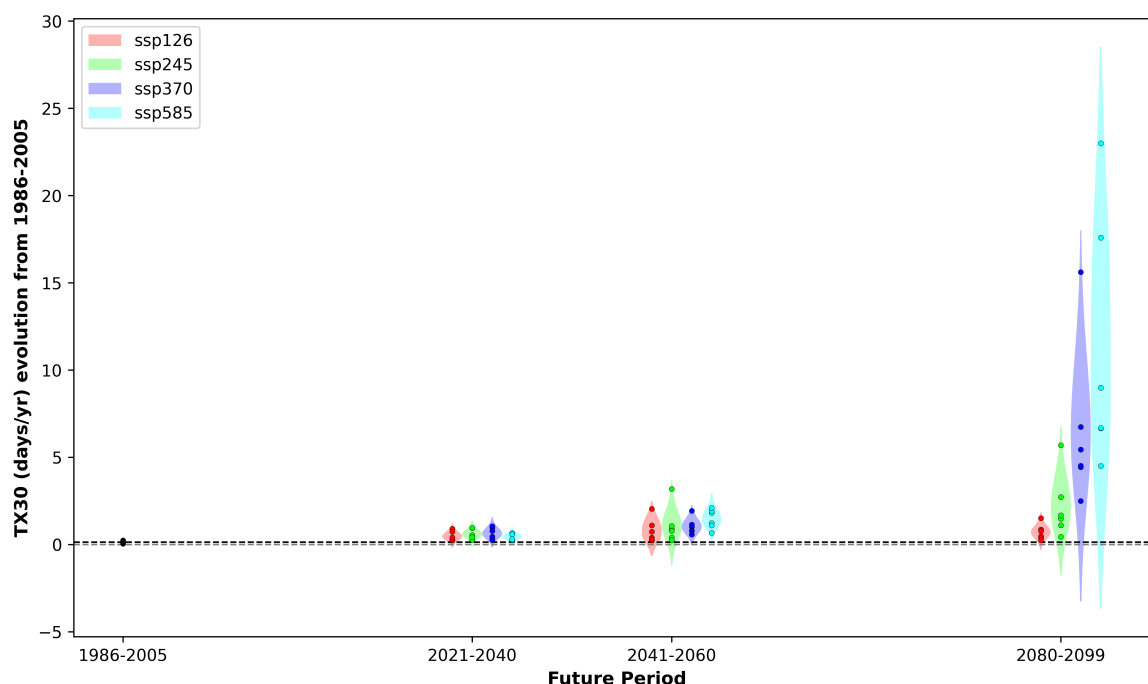


Figure 62: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Puketoi ki Tai region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based uncertainty 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](#).

15.11.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 63. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 32. The climate projections for the Puketoi ki Tai sub-region indicate a likely increase in the annual number of very hot days (above 30°C) through the 21st century, with strong scenario dependence emerging after mid-century. For the near term (2021–2040), all scenarios project a modest increase in very hot days, with multi-model means remaining below half a day per year, and a high level of consistency across models and scenarios (agreement ~64%). By mid-century (2041–2060), increases become more pronounced across all scenarios, reaching approximately 0.6–1.2 days per year depending on emissions, and spatial variability also increases.

Substantial divergence in projections emerges by late century (2080–2099), with low-emissions (SSP1-2.6) maintaining moderate increases (<1 day/yr), while high-emissions (SSP3-7.0, SSP5-8.5) produce a very likely substantial rise (5–10 days/yr mean, and maximum cases locally exceeding 13 and even 18 days/yr). Model agreement between scenarios diminishes sharply (to ~6%), indicating high scenario and inter-model sensitivity in late-century outcomes, although within-scenario spread remains credible. Spatial variability across the region also grows considerably under high-emissions futures. It is virtually certain that the frequency of extreme hot days will increase, but the magnitude of these changes by late century is extremely likely to depend on future emissions pathways.

15.11.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 64. The statistical summary of projected changes in the number of very hot days (>30°C)

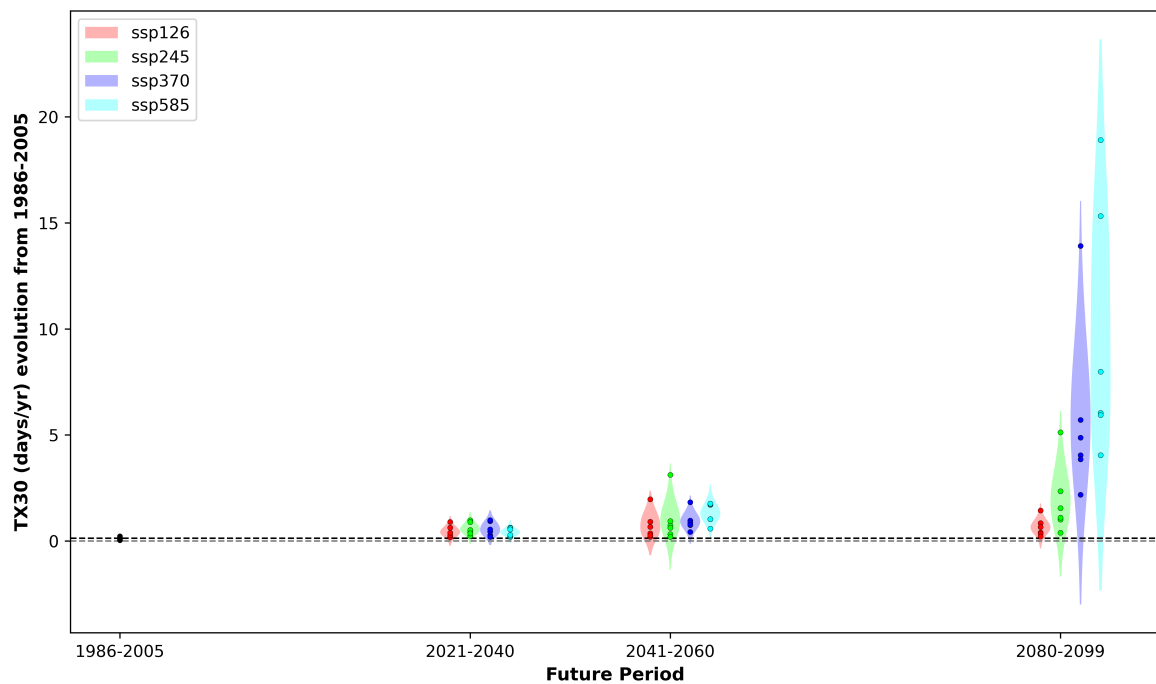


Figure 63: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Puketoi ki Tai region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

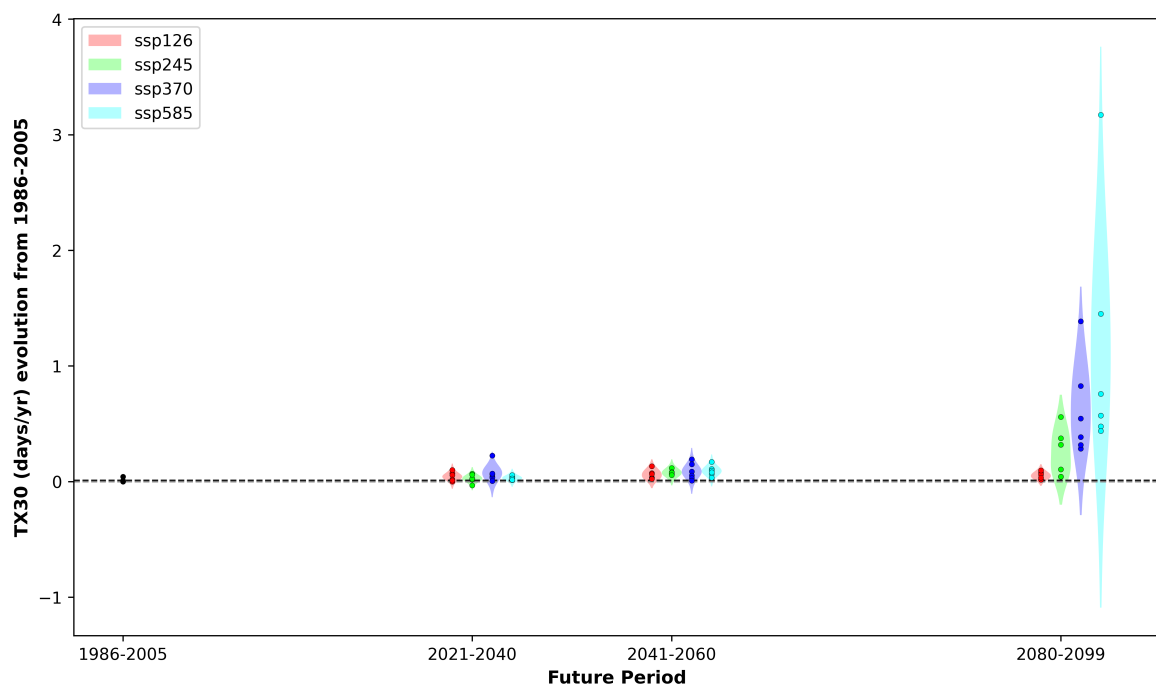


Figure 64: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Puketoi ki Tai region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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	0.13 ± 0.09	0.13 ± 0.09	0.13 ± 0.09	0.13 ± 0.09
	2021-2040	0.30 ± 0.13	0.44 ± 0.21	0.44 ± 0.22	0.29 ± 0.16
	2041-2060	0.60 ± 0.34	0.86 ± 0.38	0.81 ± 0.43	1.18 ± 0.62
	2080-2099	0.52 ± 0.29	1.80 ± 0.85	5.64 ± 1.97	9.58 ± 2.97
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.31 ± 0.13	0.45 ± 0.22	0.45 ± 0.23	0.30 ± 0.15
	2041-2060	0.63 ± 0.35	0.88 ± 0.38	0.82 ± 0.43	1.20 ± 0.63
	2080-2099	0.53 ± 0.30	1.84 ± 0.87	5.74 ± 2.00	9.84 ± 3.02
Multi-model minimum	Baseline	0.02 ± 0.04	0.02 ± 0.04	0.02 ± 0.04	0.02 ± 0.04
	2021-2040	-0.01 ± 0.07	0.06 ± 0.12	0.05 ± 0.09	-0.00 ± 0.15
	2041-2060	0.05 ± 0.17	0.06 ± 0.10	0.29 ± 0.23	0.40 ± 0.25
	2080-2099	0.06 ± 0.11	0.26 ± 0.20	2.05 ± 0.95	3.90 ± 1.69
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.12 ± 0.05	-0.01 ± 0.09	-0.07 ± 0.07	-0.03 ± 0.13
	2041-2060	-0.34 ± 0.11	-0.63 ± 0.25	0.13 ± 0.16	0.42 ± 0.34
	2080-2099	-0.11 ± 0.16	-0.56 ± 0.24	-0.10 ± 0.68	1.13 ± 1.61
Multi-model maximum	Baseline	0.25 ± 0.14	0.25 ± 0.14	0.25 ± 0.14	0.25 ± 0.14
	2021-2040	0.78 ± 0.28	0.95 ± 0.46	0.97 ± 0.40	0.60 ± 0.23
	2041-2060	1.85 ± 0.80	2.99 ± 1.14	1.71 ± 0.86	1.88 ± 0.87
	2080-2099	1.32 ± 0.69	5.00 ± 2.10	13.79 ± 4.05	18.78 ± 4.37
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.78 ± 0.27	0.96 ± 0.45	1.04 ± 0.47	0.65 ± 0.21
	2041-2060	1.72 ± 0.76	2.55 ± 0.97	1.59 ± 0.77	2.05 ± 0.97
	2080-2099	1.23 ± 0.63	4.53 ± 1.97	12.32 ± 3.71	19.77 ± 4.80

Table 32: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



over this region is shown in Table 33. Projections for the Puketoi ki Tai sub-region indicate a likely increase

Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.010 ± 0.009	0.010 ± 0.009	0.010 ± 0.009	0.010 ± 0.009
	2021-2040	0.032 ± 0.034	0.017 ± 0.022	0.062 ± 0.033	0.021 ± 0.024
	2041-2060	0.049 ± 0.041	0.067 ± 0.045	0.076 ± 0.062	0.082 ± 0.079
	2080-2099	0.040 ± 0.042	0.230 ± 0.127	0.614 ± 0.319	1.135 ± 0.562
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.033 ± 0.035	0.017 ± 0.022	0.061 ± 0.032	0.021 ± 0.024
	2041-2060	0.051 ± 0.042	0.067 ± 0.046	0.077 ± 0.063	0.082 ± 0.079
	2080-2099	0.042 ± 0.043	0.240 ± 0.133	0.628 ± 0.324	1.164 ± 0.574
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	-0.018 ± 0.024	-0.043 ± 0.026	-0.006 ± 0.016	-0.021 ± 0.027
	2041-2060	0.004 ± 0.017	-0.004 ± 0.037	-0.009 ± 0.024	0.016 ± 0.032
	2080-2099	-0.004 ± 0.020	0.012 ± 0.031	0.221 ± 0.196	0.382 ± 0.298
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.033 ± 0.021	-0.047 ± 0.027	-0.070 ± 0.037	-0.027 ± 0.022
	2041-2060	-0.028 ± 0.019	-0.003 ± 0.028	-0.044 ± 0.034	-0.001 ± 0.037
	2080-2099	-0.017 ± 0.017	-0.079 ± 0.045	-0.002 ± 0.122	-0.346 ± 0.169
Multi-model maximum	Baseline	0.045 ± 0.027	0.045 ± 0.027	0.045 ± 0.027	0.045 ± 0.027
	2021-2040	0.105 ± 0.088	0.078 ± 0.063	0.218 ± 0.109	0.072 ± 0.043
	2041-2060	0.141 ± 0.088	0.129 ± 0.076	0.217 ± 0.160	0.170 ± 0.121
	2080-2099	0.098 ± 0.087	0.570 ± 0.304	1.376 ± 0.672	3.162 ± 1.173
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.103 ± 0.084	0.078 ± 0.063	0.181 ± 0.082	0.071 ± 0.040
	2041-2060	0.138 ± 0.087	0.141 ± 0.077	0.204 ± 0.150	0.171 ± 0.131
	2080-2099	0.107 ± 0.103	0.603 ± 0.307	1.341 ± 0.609	2.873 ± 1.142

Table 33: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

in the number of very hot days (>30°C) in autumn by the end of the 21st century. Multi-model mean values show minimal change in the near term (2021–2040), remaining close to baseline across all scenarios. For mid-century (2041–2060), there is a small but gradual increase, with means ranging from around 0.05 to 0.08 days per year, implying a very low current frequency of very hot days is maintained.

By late century (2080–2099), scenario divergence becomes pronounced. The low emissions pathway (SSP1-2.6) suggests little change, while higher emissions scenarios (especially SSP3-7.0 and SSP5-8.5) indicate likely and substantial increases, with the highest scenario projecting mean changes exceeding one extra hot day per year. However, there is high spatial variability, particularly under SSP5-8.5, as reflected by the large standard deviation values across the region.

Inter-model agreement is very likely for the near and mid-term, but decreases sharply for late-century projections (agreement across scenarios drops to ~10%), reflecting greater uncertainty in outcomes for higher warming pathways. In summary, it is very likely that only modest increases in very hot days will occur under low-to-moderate emissions, but large increases become likely to extremely likely under high emissions scenarios, albeit with low confidence in the precise magnitude due to spatial and model spread.



15.11.4 Analysis for the Spring (SON) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 65. The statistical summary of projected changes in the number of very hot days (>30°C) over

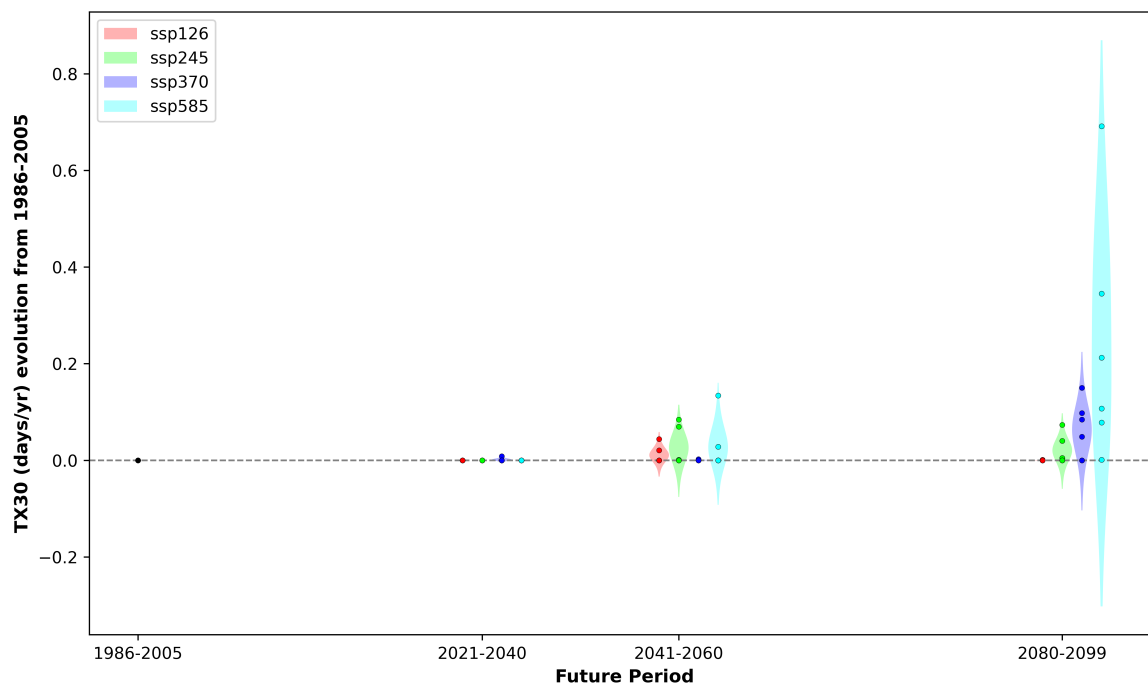


Figure 65: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Puketoi ki Tai region. The results shown here are for the Spring (SON) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis explained 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 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](#).

this region is shown in Table 34. Projections for very hot spring days (>30°C) in Puketoi ki Tai indicate minimal change throughout most of the 21st century under low and intermediate emissions scenarios (SSP126, SSP245, SSP370) until mid-century. For the baseline and 2021-2040 periods, all scenarios show virtually no increase, with multi-model means effectively at zero. By 2041-2060, a slight increase is simulated under SSP245 and SSP585 (around 0.03 days per year), but these changes remain small and spatial variability is low relative to potential maximums. The highest emissions scenario (SSP585) projects a more pronounced increase by 2080-2099, with the multi-model mean approaching a quarter of a day per year, and interquartile ranges suggesting some models simulate up to 0.7 days per year. However, across all scenarios, the absolute number of events remains low.

Model agreement across scenarios is weak for the near term (0% agreement for 2021-2040), rising slightly for 2041-2060 (about 46%) and declining again for late century (25%), indicating only low confidence in future projections, especially given the low base rate of such events. It is extremely likely that very hot spring days will remain rare in Puketoi ki Tai, even under strong warming, but increases under SSP585 are likely with low confidence due to model divergence.

The results for the Winter (JJA) season were not statistically significant and so are not shown.

15.12 Region: Middle Whangaeahu-Whanganui

Area: 1816.56 km²



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.001 ± 0.004	0.000 ± 0.000
	2041-2060	0.011 ± 0.011	0.026 ± 0.016	0.000 ± 0.002	0.027 ± 0.027
	2080-2099	0.000 ± 0.001	0.021 ± 0.017	0.063 ± 0.043	0.239 ± 0.139
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.001 ± 0.004	0.000 ± 0.000
	2041-2060	0.011 ± 0.011	0.025 ± 0.015	0.000 ± 0.002	0.028 ± 0.027
	2080-2099	0.000 ± 0.001	0.020 ± 0.018	0.063 ± 0.043	0.249 ± 0.144
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.001 ± 0.008
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	-0.004 ± 0.009	0.000 ± 0.000
	2041-2060	-0.017 ± 0.016	-0.038 ± 0.023	-0.001 ± 0.004	-0.048 ± 0.041
	2080-2099	-0.001 ± 0.004	-0.029 ± 0.018	-0.040 ± 0.018	-0.134 ± 0.045
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.009 ± 0.022	0.000 ± 0.000
	2041-2060	0.046 ± 0.043	0.090 ± 0.059	0.002 ± 0.011	0.134 ± 0.118
	2080-2099	0.001 ± 0.008	0.082 ± 0.055	0.171 ± 0.092	0.695 ± 0.307
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.006 ± 0.016	0.000 ± 0.000
	2041-2060	0.041 ± 0.038	0.083 ± 0.050	0.002 ± 0.008	0.111 ± 0.099
	2080-2099	0.001 ± 0.006	0.068 ± 0.049	0.164 ± 0.093	0.685 ± 0.335

Table 34: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



15.12.1 Analysis across all seasons

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 66. The statistical summary of projected changes in the number of very hot days (>30°C)

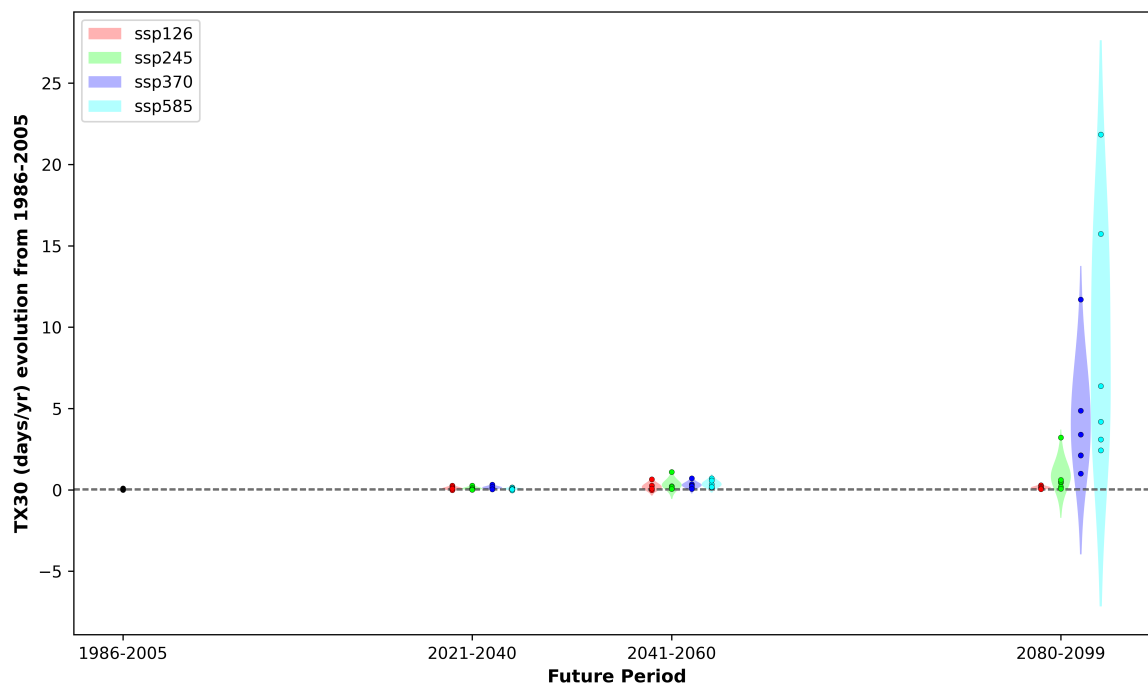


Figure 66: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Middle Whangaehu-Whanganui region. The results shown here are for the whole year (i.e. across all seasons). The violin plots show indicative uncertainties derived using the ECS-based 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](#).

over this region is shown in Table 35. For the Middle Whangaehu-Whanganui region, projections indicate a pronounced increase in the annual number of very hot days (>30°C) by late century, especially under higher emissions scenarios. During the baseline period, such days are exceedingly rare, with multi-model means near zero. Through 2021-2040 and 2041-2060, increases are modest across all scenarios (well below one day per year), with likely increases under all but the lowest emissions pathway (SSP1-2.6). By 2080-2099, however, the projected response diverges strongly between scenarios. SSP1-2.6 remains close to present conditions, with little change (multi-model mean around 0.1 days/yr). In contrast, SSP5-8.5 shows a substantial increase, with mean projections approaching 9 days/yr and maximum ensemble values exceeding 20 days/yr. SSP3-7.0 and SSP2-4.5 show intermediate changes, reaching approximately 4 and 0.8 days/yr, respectively.

The inter-model spread, and spatial variability, escalates markedly under higher forcing, especially by 2080-2099 for SSP3-7.0 and SSP5-8.5, indicating reduced confidence in absolute magnitudes but robust directional change. Agreement across scenarios declines to 19% by century's end, reflecting strong scenario dependence. It is virtually certain that very hot days will increase under higher emissions, with the increase likely to remain limited under strong mitigation (SSP1-2.6).

15.12.2 Analysis for the Summer (DJF) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 67. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 36. For Middle Whangaehu-Whanganui, the number of very hot summer days



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02
	2021-2040	0.06 ± 0.06	0.06 ± 0.08	0.12 ± 0.15	0.04 ± 0.05
	2041-2060	0.16 ± 0.14	0.27 ± 0.28	0.27 ± 0.25	0.33 ± 0.32
	2080-2099	0.12 ± 0.14	0.82 ± 0.69	4.17 ± 2.98	8.92 ± 5.23
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.07 ± 0.06	0.06 ± 0.08	0.12 ± 0.16	0.04 ± 0.05
	2041-2060	0.16 ± 0.14	0.28 ± 0.28	0.27 ± 0.25	0.34 ± 0.32
	2080-2099	0.12 ± 0.14	0.84 ± 0.71	4.28 ± 3.05	9.24 ± 5.40
Multi-model minimum	Baseline	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	2021-2040	-0.06 ± 0.04	-0.04 ± 0.04	-0.01 ± 0.04	-0.06 ± 0.04
	2041-2060	-0.05 ± 0.04	0.01 ± 0.06	0.03 ± 0.06	0.10 ± 0.20
	2080-2099	-0.01 ± 0.04	0.04 ± 0.08	0.97 ± 0.83	2.40 ± 2.24
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.08 ± 0.04	-0.09 ± 0.07	-0.03 ± 0.03	-0.07 ± 0.04
	2041-2060	-0.19 ± 0.08	-0.27 ± 0.16	-0.06 ± 0.07	-0.02 ± 0.16
	2080-2099	-0.05 ± 0.04	-0.80 ± 0.51	-1.23 ± 0.34	-2.30 ± 1.26
Multi-model maximum	Baseline	0.09 ± 0.05	0.09 ± 0.05	0.09 ± 0.05	0.09 ± 0.05
	2021-2040	0.23 ± 0.17	0.25 ± 0.29	0.30 ± 0.31	0.17 ± 0.11
	2041-2060	0.62 ± 0.36	1.07 ± 0.88	0.69 ± 0.63	0.72 ± 0.50
	2080-2099	0.33 ± 0.35	3.19 ± 2.42	11.67 ± 7.34	21.82 ± 9.30
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.24 ± 0.16	0.23 ± 0.25	0.29 ± 0.32	0.16 ± 0.10
	2041-2060	0.56 ± 0.38	0.89 ± 0.74	0.64 ± 0.57	0.74 ± 0.53
	2080-2099	0.30 ± 0.32	2.62 ± 2.03	10.55 ± 6.75	22.41 ± 10.42

Table 35: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02	0.03 ± 0.02
	2021-2040	0.06 ± 0.06	0.06 ± 0.08	0.11 ± 0.14	0.04 ± 0.05
	2041-2060	0.15 ± 0.13	0.26 ± 0.26	0.26 ± 0.24	0.31 ± 0.29
	2080-2099	0.11 ± 0.13	0.78 ± 0.63	3.89 ± 2.72	8.11 ± 4.57
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.06 ± 0.06	0.06 ± 0.08	0.11 ± 0.14	0.04 ± 0.05
	2041-2060	0.16 ± 0.13	0.27 ± 0.26	0.26 ± 0.24	0.32 ± 0.30
	2080-2099	0.11 ± 0.13	0.80 ± 0.65	4.00 ± 2.78	8.42 ± 4.73
Multi-model minimum	Baseline	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	2021-2040	-0.06 ± 0.04	-0.04 ± 0.04	-0.02 ± 0.04	-0.06 ± 0.04
	2041-2060	-0.05 ± 0.04	0.01 ± 0.06	0.02 ± 0.06	0.10 ± 0.20
	2080-2099	-0.01 ± 0.03	0.02 ± 0.05	0.93 ± 0.79	2.17 ± 1.97
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.09 ± 0.05	-0.09 ± 0.08	-0.04 ± 0.04	-0.07 ± 0.04
	2041-2060	-0.20 ± 0.08	-0.28 ± 0.17	-0.06 ± 0.07	-0.02 ± 0.17
	2080-2099	-0.06 ± 0.04	-0.78 ± 0.48	-1.05 ± 0.26	-1.76 ± 1.37
Multi-model maximum	Baseline	0.09 ± 0.05	0.09 ± 0.05	0.09 ± 0.05	0.09 ± 0.05
	2021-2040	0.23 ± 0.17	0.25 ± 0.29	0.29 ± 0.31	0.17 ± 0.11
	2041-2060	0.62 ± 0.36	1.05 ± 0.86	0.67 ± 0.61	0.69 ± 0.46
	2080-2099	0.33 ± 0.35	3.07 ± 2.23	10.74 ± 6.48	18.98 ± 7.43
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.23 ± 0.16	0.23 ± 0.25	0.28 ± 0.30	0.16 ± 0.10
	2041-2060	0.55 ± 0.36	0.87 ± 0.71	0.62 ± 0.55	0.70 ± 0.48
	2080-2099	0.29 ± 0.31	2.53 ± 1.88	9.73 ± 6.00	20.01 ± 8.76

Table 36: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

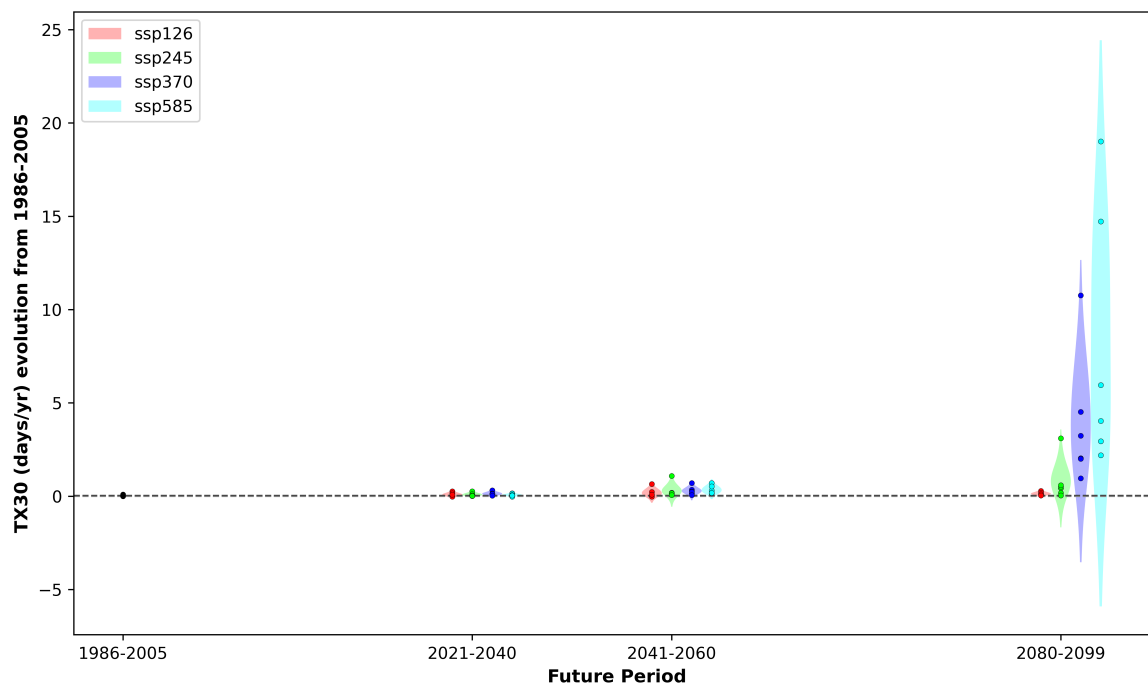


Figure 67: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Middle Whangaehu-Whanganui region. The results shown here are for the Summer (DJF) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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 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](#).

(>30°C) is projected to increase with future warming, with the magnitude of change strongly dependent on emissions scenario. In the baseline period, very hot days were virtually absent. Up to mid-century (2041–2060), all scenarios project only a slight rise in TX30, remaining well below one day per year, and differences between scenarios are minor. This period shows moderate inter-scenario agreement (about 58%), suggesting likely ($\geq 66\%$) confidence in a modest increase.

By late century (2080–2099), substantial divergence between scenarios emerges. Under low (SSP1-2.6) and intermediate (SSP2-4.5) emissions, TX30 remains well below one day/year on average, and only isolated years or locations may experience any very hot days. Under high (SSP3-7.0, SSP5-8.5) emissions, however, TX30 rises markedly, with SSP5-8.5 averaging over eight days/year regionally and reaching up to nearly 19 days/year. The spread across models increases sharply for high emissions, reflecting decreased inter-model and inter-scenario agreement (agreement falls to just 16% for the end-of-century periods), so these high values are likely but with only medium confidence.

In summary, very hot days remain rare through mid-century, but under high emissions a substantial increase is very likely by late century, albeit with considerable inter-model spread and reduced confidence.

15.12.3 Analysis for the Autumn (MAM) season

A plot of the evolution in number of very hot days (>30°C) from the 1986-2005 baseline over this region is shown in Figure 68. The statistical summary of projected changes in the number of very hot days (>30°C) over this region is shown in Table 37. Projections for the number of very hot days (>30°C) in autumn in the Middle Whangaehu-Whanganui region show very low baseline and near-term (2021-2060) values, with virtually no exceedance of 30°C events across all scenarios. In the baseline and out to mid-century, the multi-model mean remains near zero days per year, and models show high agreement—indicating with high confidence that very hot days will remain rare in the near-term, regardless of emissions pathway.



Metric	Period	SSP scenario			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Multi-model mean	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.004 ± 0.005	0.002 ± 0.004	0.013 ± 0.013	0.000 ± 0.000
	2041-2060	0.006 ± 0.009	0.011 ± 0.015	0.004 ± 0.009	0.006 ± 0.012
	2080-2099	0.003 ± 0.004	0.029 ± 0.051	0.220 ± 0.228	0.639 ± 0.615
Multi-model P50	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.004 ± 0.005	0.002 ± 0.004	0.013 ± 0.013	0.000 ± 0.000
	2041-2060	0.006 ± 0.009	0.012 ± 0.016	0.004 ± 0.009	0.006 ± 0.012
	2080-2099	0.003 ± 0.004	0.030 ± 0.052	0.227 ± 0.235	0.659 ± 0.631
Multi-model minimum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2041-2060	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2080-2099	0.000 ± 0.000	0.000 ± 0.000	0.022 ± 0.042	0.116 ± 0.190
Multi-model P5	Baseline	N/A	N/A	N/A	N/A
	2021-2040	-0.010 ± 0.013	-0.004 ± 0.008	-0.035 ± 0.035	0.000 ± 0.000
	2041-2060	-0.013 ± 0.019	-0.011 ± 0.012	-0.005 ± 0.010	-0.006 ± 0.011
	2080-2099	-0.007 ± 0.011	-0.032 ± 0.052	-0.160 ± 0.120	-0.460 ± 0.210
Multi-model maximum	Baseline	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
	2021-2040	0.024 ± 0.031	0.011 ± 0.022	0.079 ± 0.077	0.000 ± 0.000
	2041-2060	0.034 ± 0.049	0.037 ± 0.043	0.014 ± 0.031	0.020 ± 0.036
	2080-2099	0.018 ± 0.025	0.117 ± 0.192	0.748 ± 0.726	2.189 ± 1.698
Multi-model P95	Baseline	N/A	N/A	N/A	N/A
	2021-2040	0.018 ± 0.022	0.008 ± 0.017	0.058 ± 0.056	0.000 ± 0.000
	2041-2060	0.028 ± 0.040	0.037 ± 0.045	0.013 ± 0.028	0.020 ± 0.036
	2080-2099	0.013 ± 0.018	0.098 ± 0.162	0.665 ± 0.630	1.914 ± 1.553

Table 37: The statistics of the projected changes in the number of very hot days (>30°C) in units of days/yr 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).

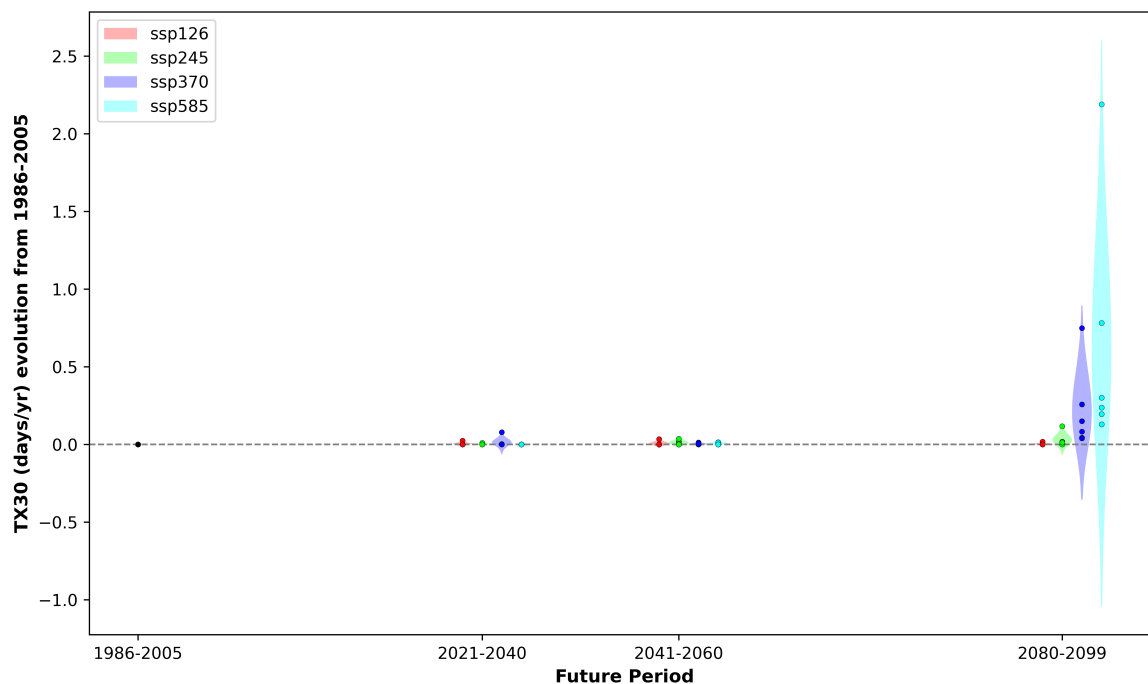


Figure 68: The time evolution of number of very hot days (>30°C) from the 1986-2005 baseline in units of days/yr over the Middle Whangaehu-Whanganui region. The results shown here are for the Autumn (MAM) season. The violin plots show indicative uncertainties derived using the ECS-based uncertainty analysis 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](#).

By late century (2080-2099), differences between scenarios emerge. Under low (SSP1-2.6) and intermediate (SSP2-4.5) emissions, increases remain marginal, with mean changes well below one day/year. Under high emissions (SSP3-7.0 and especially SSP5-8.5), some models indicate the potential for much larger increases—up to around 2 additional very hot days per year in extreme outliers for SSP5-8.5—but the ensemble mean still sits below one day per year. The wide spread, especially in SSP5-8.5, reflects substantial inter-model and spatial variability, and scenario agreement falls to about 31%.

It is very likely that very hot days will remain rare in Middle Whangaehu-Whanganui through 2060, regardless of emissions. High emissions scenarios suggest a likely, but not certain, increase in rare very hot days by 2100, although confidence is reduced by model spread.

The results for the Winter (JJA) and Spring (SON) seasons were not statistically significant and so are not shown.