Indicators of temperature, climate change, and health

HIGHLIGHTS:

- **A temperature rise between 0.7°C and 3.0°C by 2090 (relative to 1986–2005) is estimated for New Zealand.**
- **Northern and eastern New Zealand are currently more affected by hot days, especially Bay of Plenty, Marlborough and northern Canterbury regions.**
- **Northland, the east coast of the North Island, and parts of the Bay of Plenty are likely to be regions where people will be particularly affected by the direct health effects of temperature extremes, as they have populations more vulnerable to heat.**

This factsheet presents indicators of extreme temperature (hot days and cold days) and an indicator of the indirect health effects of temperature increase (salmonellosis: a gastro-intestinal disease). It also comments on the current overlap in where temperature extremes occur, and the geographical distribution of populations more vulnerable to heat and salmonellosis.

About temperature, health, and climate change

New Zealand is becoming warmer

+0.97°C last 100 years	Over the **period 1909–2017,** the mean annual temperature in New Zealand rose at a rate of 0.97°C per 100 years (NIWA n.d.).
2016 warmest year since 1908	The year 2016 was our warmest year since 1908 (Ministry for the Environment and Stats NZ 2017).

+0.7–1.0°C by 2040	Climate scientists predict that relative to 1986-2005, New Zealand will continue to warm by 0.7°C–1.0°C by the **year 2040** (Ministry for the Environment 2016).
+0.7–3.0°C by 2090	Climate scientists predict that relative to 1986–2005, New Zealand will continue to warm by 0.7°C–3.0°C by the **year 2090** (Ministry for the Environment 2016).

It is very likely that with climate change there will be an increase in the number of hot days (maximum temperature above 25°C), particularly in the north of the North Island. Additionally, there will be a decrease in the number of cold days (minimum temperatures below 0°C), particularly in the South Island (Ministry for the Environment 2016).

A warmer climate has several effects on health

The projected temperature changes for New Zealand are enough to affect our health directly. Some temperature changes will benefit health:

- **Deaths and hospitalisations:** Less cold days will result in fewer cold-related deaths and hospitalisations from cardiorespiratory (heart and lung) conditions.

However, any reduction in cold-related health effects is likely to be outweighed by a projected increase in heat-related death and illness (Smith et al 2017).

Indicators of temperature, climate change, and health

A warmer climate alters biological processes in our environment that can affect our health. Increased temperatures can affect health in several ways.

- **gastrointestinal infections:** The rate of gastrointestinal infections is affected by temperature. Research suggests that periods of higher temperatures are linked to an increase in salmonellosis notifications (Britton et al 2010).
- **infectious diseases:** Increasing temperatures can change the geographical distribution of some mosquitoes, carrying infectious diseases.
- **respiratory problems:** Increasing temperatures bring a longer pollen season and increased fire risk, associated with increases in respiratory problems.
- **cardiac (heart) problems:** Heat is linked to worsening of heart problems and to an increase in overall death rates (Hales et al 2007; McMichael et al 2003).

High temperatures and population vulnerability

Populations that are more vulnerable to temperature-related health effects are:

- older people **85 years and over** (eg, medications that cause water loss, more quickly dehydrated from 'tummy bugs')
- those with **chronic disease or disability** (eg, cardiovascular disease, mental illness)
- **Māori** communities (eg, high employment in outdoor occupations)
- young children **aged 0-4 years** (eg, have fewer sweat glands than adults, more quickly dehydrated from tummy bugs)
- those on **low incomes** (eg, if you do not have money for transport, it can be hard to get to a swimming pool or beach to cool down).

For more information about population vulnerability and climate change, please download the Vulnerability to climate change factsheet.

Monitoring temperature extremes in New Zealand

Two temperature-related indicators of climate and health are daily extreme temperatures. Temperature extremes relate most strongly to health effects:

number of hot days per year	number of cold days per year
maximum daily temperature above 25°C	minimum daily temperature below 0°C

Increasing temperatures will result in an increasing number of hot days and a reduced number of cold days. By 2100, many places in New Zealand may experience over 80 days with temperatures above 25°C (Royal Society Te Apārangi 2017).

Hot days more common in the north and east

Data from 2015–17 show hot days are more common in the north and east of both islands (Figure 1), whereas cold days are most frequent in parts of the South Island (Figure 3) (Table 1).

Table 1: Territorial Authorities (TA) with the highest annual average number of hot days (left) and cold days (right), 2015–17

number of hot days		number of cold days	
Kawerau District (Bay of Plenty)	86	Hurunui District (Canterbury)	113
Central Otago (Otago)	72	Mackenzie District (Canterbury)	93
Wairoa District (Hawke's Bay)	69	Central Otago (Otago)	90

Note: Averages are the annual number of hot days for the TA, averaged over the time period 2015–17.

Source: National Climate Database (CliFlo), NIWA

Our website shows how these temperature extremes have changed over the past 18 years.

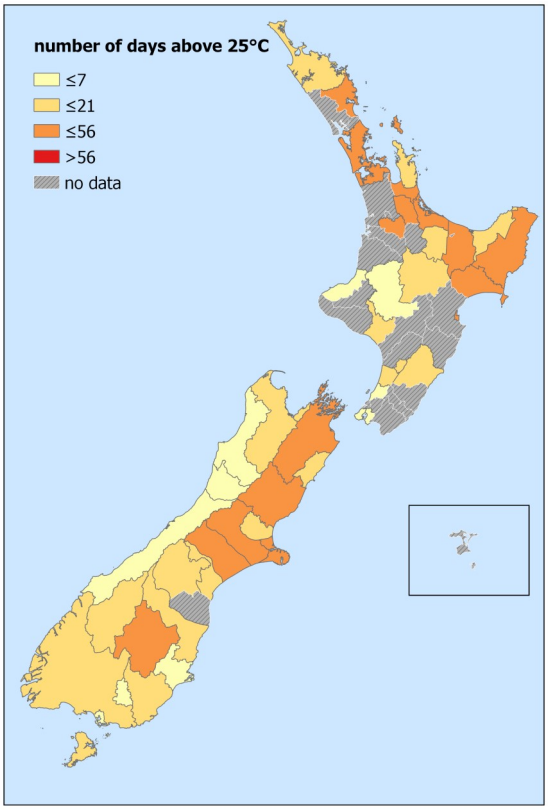
According to the Ministry for the Environment's and Statistics New Zealand environmental reporting, the number of hot days increased across New Zealand, looking at combined weather station data over the period 1972/73 to 2015/16 (Figure 2). In contrast, there was no time trend for New Zealand for cold days between 1972 and 2016 (Figure 4) (Ministry for the Environment and Stats NZ 2017).

People in Northland, east coast of the North Island and parts of Bay of Plenty likely to experience health effects of temperature rise

Combining temperature and population data shows that **Northland**, the **east coast of the North Island**, and **parts of the Bay of Plenty** are likely to be regions where people will be particularly affected by the direct health effects of temperature increases. For example, many Māori live in the north and east of New Zealand, where hot days are projected to increase (Ministry for the Environment 2016). There are also high numbers of older people aged 85 years and over living in northern and eastern areas such as Christchurch city, Auckland city, Whangarei and Hastings.

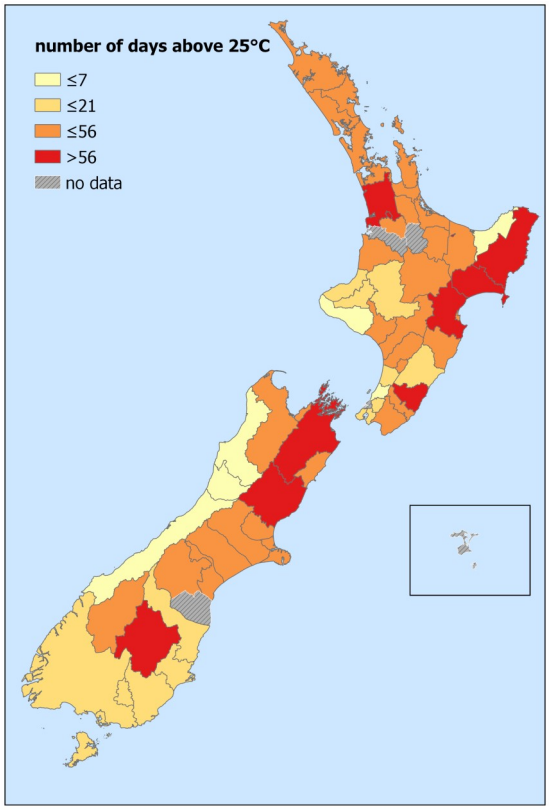
For more information about population vulnerability and climate change please download the Vulnerability to climate change factsheet.

Figure 1a: Annual average number of days with temperatures above 25°C, by Territorial Authority (TA), 2000–02



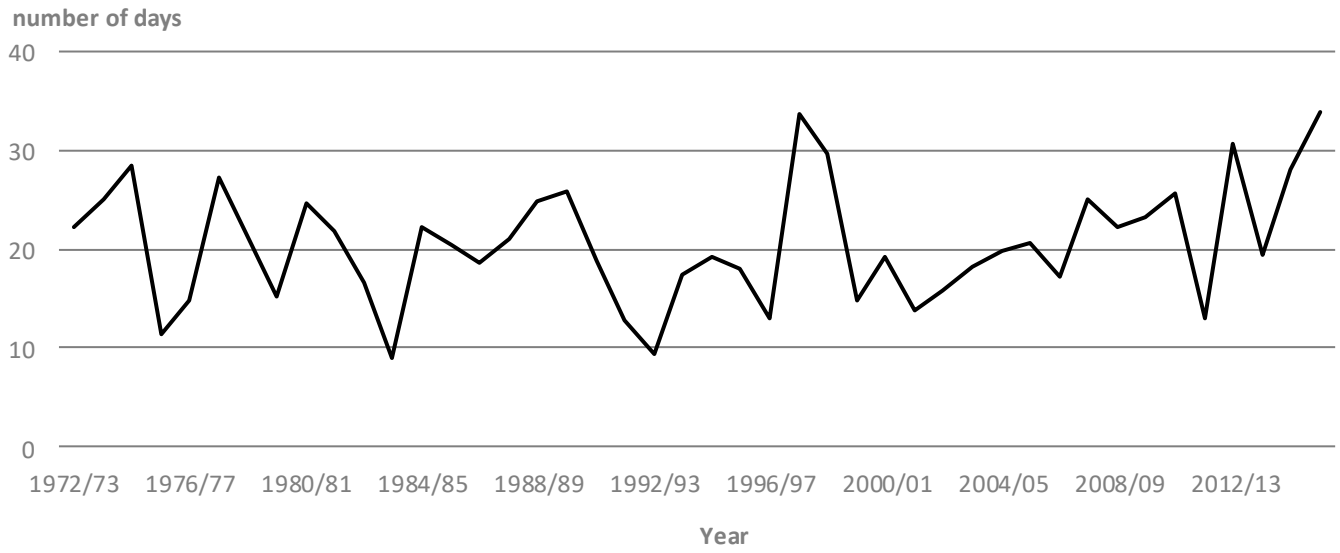
Note: Averages are the annual number of hot days for the TA, averaged over the time period 2000–02.
Source: National Climate Database (CliFlo), NIWA

Figure 1b: Annual average number of days with temperatures above 25°C, by Territorial Authority (TA), 2015–17



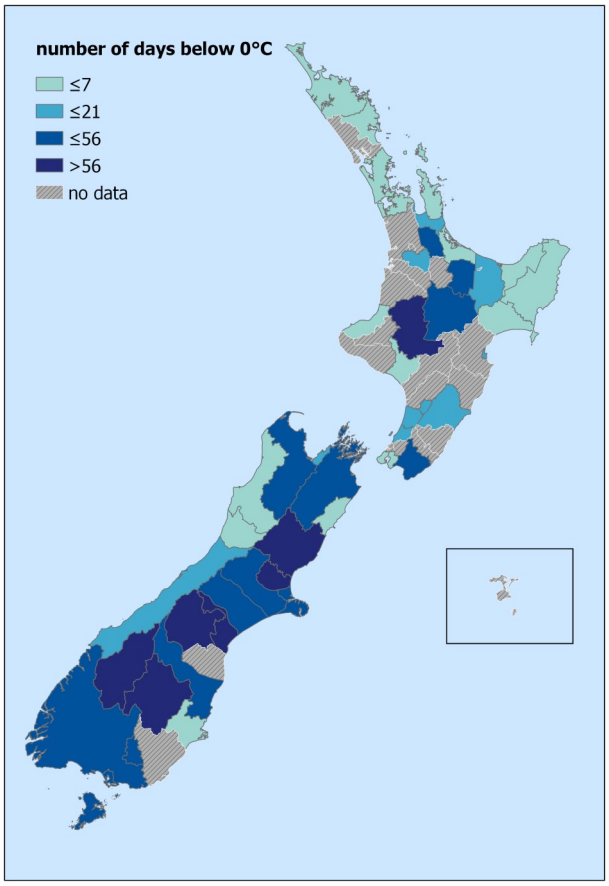
Note: Averages are the annual number of hot days for the TA, averaged over the time period 2015–17.
Source: National Climate Database (CliFlo), NIWA

Figure 2: Average number of days with temperatures above 25°C, New Zealand, 1972/73–2012/13



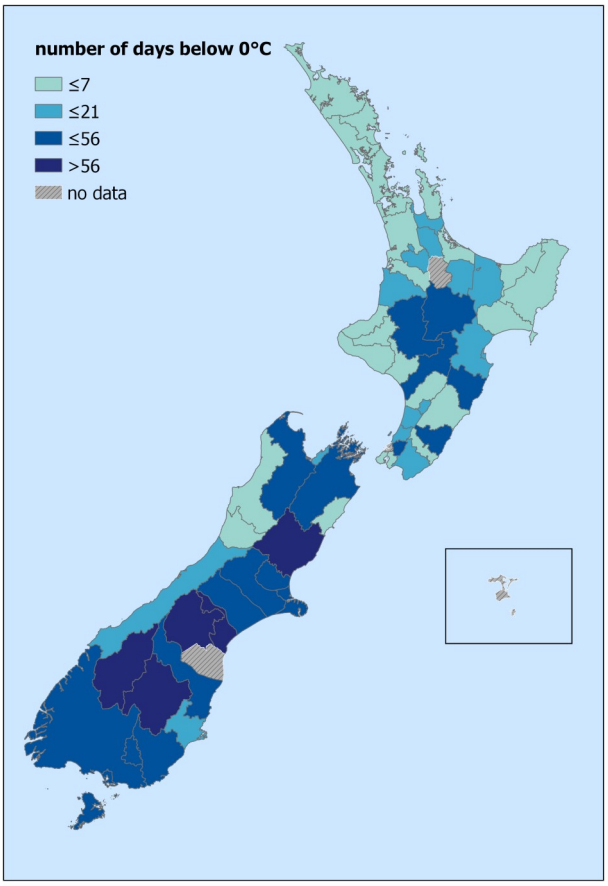
Note: Averages are the annual number of hot days per growing season (1 July—30 June), averaged geographically across weather stations for New Zealand.
Source: Ministry for the Environment and Stats NZ 2017

Figure 3a: Annual average number of cold days with temperatures below 0°C, by Territorial Authority (TA), 2000–02



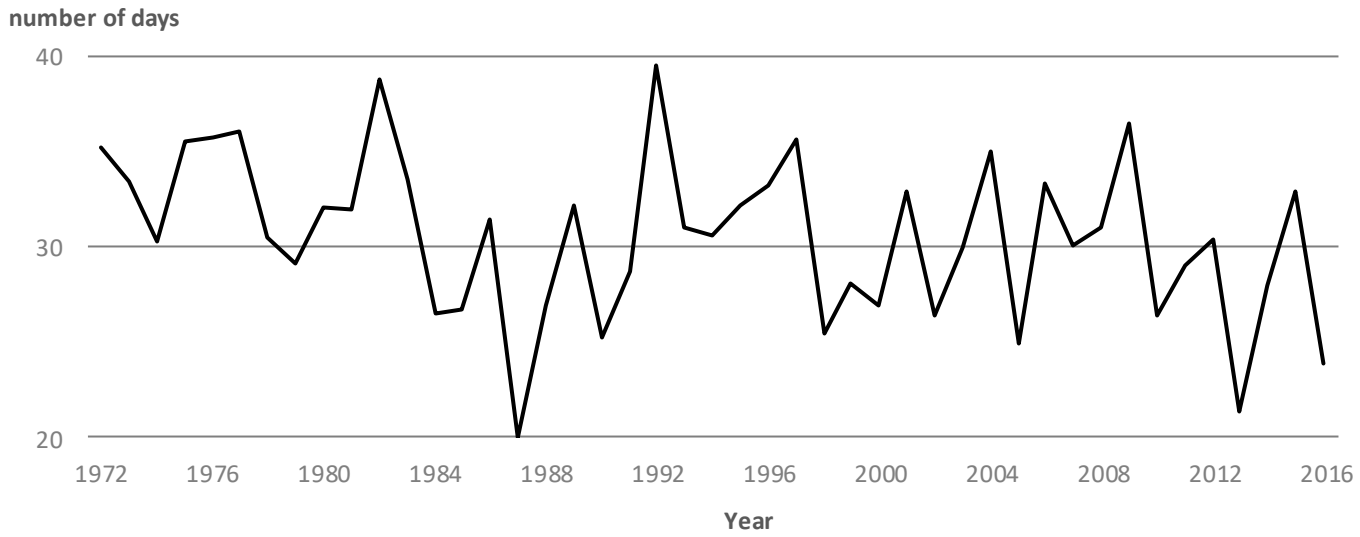
Note: Averages are the annual number of days below 0°C for the TA, averaged over the time periods 2000–02 and 2015–17.
Source: National Climate Database (CliFlo), NIWA

Figure 3b: Annual average number of cold days with temperatures below 0°C, by Territorial Authority (TA), 2015–17



Note: Averages are the annual number of days below 0°C for the TA, averaged over the time periods 2000–02 and 2015–7.
Source: National Climate Database (CliFlo), NIWA

Figure 4: Average number of days with temperatures below 0°C, New Zealand, 1972/73–2012/13



Note: Averages are the annual number of days below 0°C (1972-2016), averaged geographically across weather stations for New Zealand.
Source: Ministry for the Environment and Stats NZ 2017

Monitoring health effects of temperature increase

Salmonellosis (gastro-intestinal infection) is a climate-sensitive disease already present in New Zealand that has been linked to temperature. A 1°C increase in monthly average temperature was associated with a 15% increase in salmonellosis notifications in one New Zealand study (Britton et al 2010).

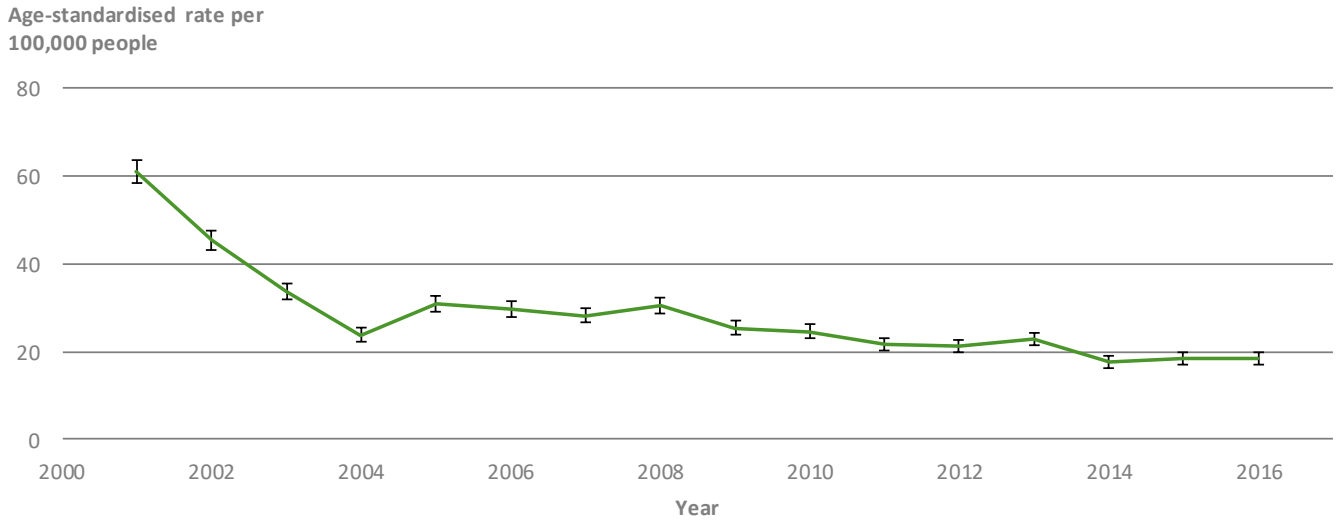
notifications of salmonellosis
age-standardised rate of salmonellosis notifications

Salmonellosis notification rate decreasing

The age-standardised rate of **salmonellosis** notifications decreased between 2001 and 2004 from 56.6 per 100,000 to 21.9 per 100,000 (Figure 5), which is thought to be primarily due to improved food safety (Britton et al 2010). Between 2004 and 2016, notifications also decreased but by a smaller amount (21.9 per 100,000 to 17.1 per 100,000).

Overall, the rate of salmonellosis notifications has **decreased over time** from 2001 to 2016.

Figure 5: Salmonellosis notifications, 2001-2016 (age-standardised rate per 100,000)



Source: EpiSurv, ESR

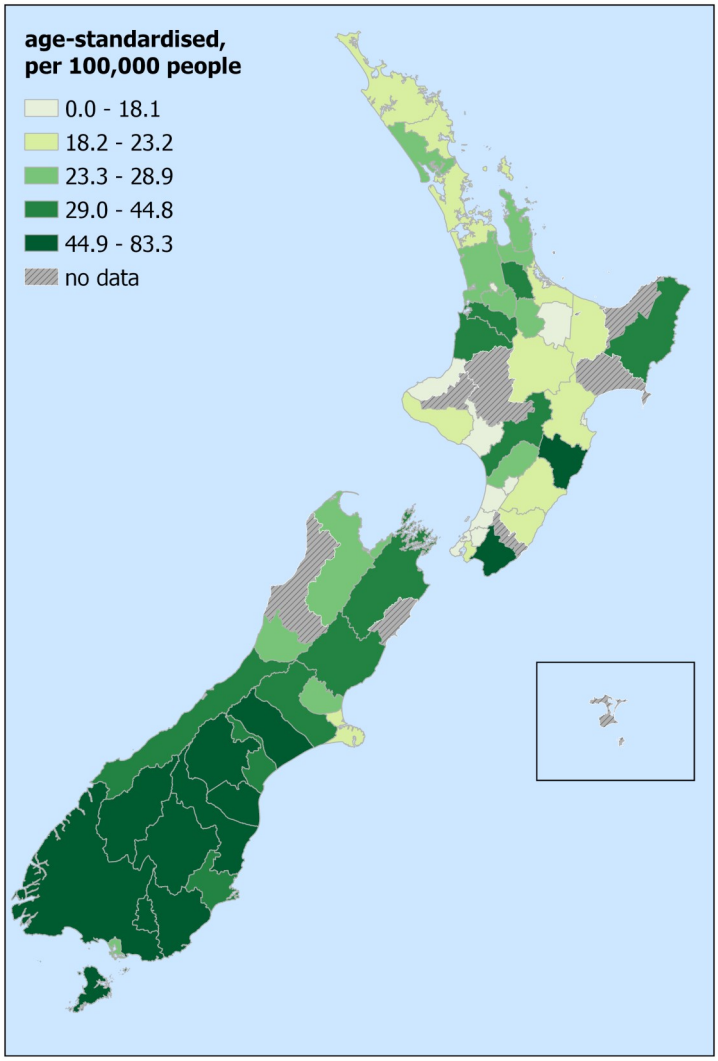
Ongoing monitoring on health effects of climate change needed

In 2007–16, the highest age-standardised rates (per year) of salmonellosis are in the lower part of the South Island (Figure 6):

- **Mackenzie District** (Canterbury): 83 per 100,000
- **Central Otago District** (Otago): 75 per 100,000
- **Clutha District** (Otago): 74 per 100,000

Long term health data, ideally from before 1990, are needed to robustly examine changes in disease occurrence and severity due to climate change. However, it is important to have ongoing monitoring of health effects in anticipation of possible increases as climate change makes itself felt.

Figure 6: Salmonellosis notifications, by Territorial Authority (TA), 2007-16 (age-standardised rate per 100,000)



Temperature extremes, vulnerable populations and climate-sensitive infectious diseases

The highest rates of salmonellosis notifications tend to be in different regions from those with high numbers of hot days and populations vulnerable to infectious gastro-intestinal diseases. Rather, the highest rates of salmonellosis are often in regions that experience high numbers of cold days. One exception to this is Central Otago, which shows high rates of salmonellosis, hot days as well as cold days, and has a moderate size older population aged 85 years and over.

Source: EpiSurv, ESR

FURTHER INFORMATION

Related environmental health indicators for Climate Change are available from the **EHINZ website.**

DATA FOR THESE INDICATORS

Number of hot days and number of cold days

Climate station data of the daily maximum and minimum temperatures from around New Zealand was sourced from the National Institute of Water and Atmospheric Research (NIWA). One climate station was used per TA, except for Auckland City for which data from three weather stations were averaged. Two time points of three years combined data are used to give a sense of change in occurrence of temperature extremes, as well as which parts of New Zealand have high numbers of hot days or cold days. The number of days over 25°C and under 0°C per year for each TA has been averaged over the three-year time period. Specific change over time corresponding with climate change cannot be shown as the common baseline period in climate change science is 1960–1990, for which comparable data is not available.

Notifications of salmonellosis

This indicator presents salmonellosis notifications from EpiSurv data from ESR for 2001–2016. Notifications where the person was overseas during the incubation period have been excluded. Notifications only cover those people who visited a GP or hospital for treatment, and may therefore underestimate the disease rate. Specific change over time corresponding with climate change cannot be shown as the common baseline period in climate change science is 1960–1990, for which comparable data is not available .

Rates presented are per 100,000 people (or 100,000 people per year for combined data over 10-year periods). Age-standardised rates have been presented where possible, to take into account the population age structures of different population groups. 95% confidence intervals have been presented as error bars on graphs.

Additional information for these indicators is available in the **Metadata sheets.**

REFERENCES

Britton E, Hales S, Venugopal K, et al. 2010. Positive association between ambient temperature and salmonellosis notifications in New Zealand. *Australian and New Zealand Journal of Public Health* 34(2): 126-9. DOI: 10.1111/j.1753-6405.2010.00495.x (accessed 23 October 2018).

Hales S, Salmond C, Town GI, et al. 2007. Daily mortality in relation to weather and air pollution in Christchurch, New Zealand. Australian and New Zealand Journal of Public Health 24(1): 89-91. DOI: 10.1111/j.1467-842X.2000.tb00731.x (accessed 23 October 2018).

McMichael AJ, Woodruff R, Whetton P, et al. 2003. *Human health and climate change in Oceania: A risk assessment*. Canberra: Commonwealth of Australia.

Ministry for the Environment. 2016. *Climate change projections for New Zealand: Atmospheric projections based on simulations undertaken for the IPCC 5th Assessment*. Wellington: Ministry for the Environment.

Ministry for the Environment and Stats NZ. 2017. *New Zealand's Environmental Reporting Series: Our atmosphere and climate*. Wellington: Ministry for the Environment and Stats NZ.

NIWA (National Institute of Water and Atmospheric Research). n.d. 'Seven-station' series temperature data. URL: https://www.niwa.co.nz/our-science/climate/information-and-resources/nz-temp-record/seven-station-series-temperature-data (accessed 23 October 2018).

Royal Society Te Apārangi. 2017. *Human health impacts of Climate Change for New Zealand. Evidence Summary*. Wellington: Royal Society Te Apārangi.

Smith KR, Woodward A, Campbell-Lendrum D, et al. 2014. Human Health: Impacts, Adaptation, and Co-Benefits. In: Barros VR, Field C, Dokken D, et al (eds). *Climate Change 2014: Impacts, Adaptation, and Vulnerability Part B: Regional Aspects Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 709-754). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

AUTHOR

The author of this factsheet is Carolin Haenfling, for more information please email (ehinz@massey.ac.nz).

CITATION

Environmental Health Indicators Programme. 2019. *Indicators of temperature, climate change, and health.* [Factsheet]. Wellington: Environmental Health Indicators Programme, Massey University.