

Information topic	Details
Indicator name	Number of days below 0°C
Domain and topic	Climate change: Temperature
Indicator definition and units	Number of days with minimum air temperature below 0°C
Data source	CliFlo. NIWA's National Climate Database. URL: https://cliflo.niwa.co.nz/
Numerator	Annual number of days with a minimum temperature below 0°C by Territorial Authority (TA)
Methodology	<p>Weather stations were selected based on their proximity to the population-weighted centroid for a TA as well as completeness of data for the period 2000-onwards.</p> <p>One weather station per TA was selected. However, three dispersed weather stations (North Shore, Henderson, and Mangere) were selected and averaged for Auckland due to the significant population size in comparison to the rest of the country.</p> <p>Using the population-weighted centroid coordinates for each TA, we looked at weather stations within a 25km radius. The weather station closest to the centroid was selected, provided it had complete data from the year 2000 for temperature and soil moisture. Where there was insufficiently complete data, we then examined the next closest weather station, and so on until the 'best fit' was found. Selected weather stations were 0.2-36.8km from the centroid, with a mean of 7.2km from the centroid. In three cases, a weather station is used for two TAs (Otorohanga/Waitomo, Masterton/Carterton, Lower Hutt/Upper Hutt). If a weather station's data had over 5% missing data for a calendar year, results for that year were excluded from analysis.</p> <p>The population-weighted centroid of a TA was calculated from Census data, using the geographic centroid of meshblocks (small Census area description) weighted by their usual resident population.</p> <p>The number of days below 0°C has been averaged over a three-year time period.</p>
Time period and time scale	Annual; from 2000 onwards
Spatial Coverage	National; by TA

Measures of frequency	<ul style="list-style-type: none"> - Average number of days per year below 0°C - Average number of days per year below 0°C, by TA
Limitations of indicator	<ul style="list-style-type: none"> - The indicator does not directly show 'change'. This is because we could not robustly compare a 'baseline period' with the 2000-onwards data. A common baseline period in climate change science is 1960-1990 (Mearns et al 2001). The 2000-onwards data that we used did not have a sufficiently comparable 1960-1990 period, because weather station collection sites (and data reliability) have changed over time. - Counting the number of days with a pre-determined minimum temperature has the effect of reducing a continuous variable (temperature) to a binary one (below 0°C). This gives a clear picture for an indicator purpose, but it also reduces the underlying data to use as an indicator only. - There will be geographic variation in temperature across a TA that is not represented in this indicator because we have used one weather station per TA (except for Auckland). - The use of population centroids will increase the risk of an 'urban heat island effect' (Haines and Patz 2004) becoming a confounder. An urban heat island is a metropolitan area that is warmer than its surrounding rural areas because of human activities. If urbanisation is occurring at the same time as climate change then distinguishing between the two effects might be problematic.
Limitations of data source	Some of the selected weather stations have missing data, usually due to starting collection after the year 2000.
Created by	Environmental Health Indicators Programme, Massey University
Related indicators	<ul style="list-style-type: none"> - Number of days over 25°C - Number of days with soil moisture deficit - Notifications of salmonellosis - Notifications of cryptosporidiosis and giardiasis
For more information	Ministry for the Environment. Our atmosphere and climate 2017. Available from https://www.mfe.govt.nz/node/23688/ (accessed December 2018)
References	<ul style="list-style-type: none"> - Haines A, Patz JA. 2004. Health effects of climate change. <i>Journal of the American Medical Association</i> 291(1): 99-103. DOI: 10.1001/jama.291.1.99 (accessed 27 November 2018). - Mearns LO, Hulme M, Carter TR, et al. 2001. Climate Scenario Development. In: Houghton JT, Ding Y, Griggs M, et al. (eds). <i>Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change</i>

	(pp. 739-768). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
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