

INDICATOR DATASHEET: NUMBER OF DAYS BELOW 0°C

Type of Indicator	Weather Climate change
Definition and units	Annual number of days with minimum air temperature below 0°C
Data source	CliFlo (the web system that provides access to NIWA’s national climate database). NIWA is the National Institute of Water and Atmospheric Research.
Geographic Scope	New Zealand (NZ), broken down into 71 Territorial Authorities (TAs)
Temporal Scope	Calendar year, from 2000 onwards. Factsheet shows 2004-2013 average due to missing values prior to 2004.
Rationale	<p>Climate change models project that NZ will become warmer, with a decrease in the number of extreme cold days. Health effects of temperature are associated with ‘extreme’ temperature days, more than with changes in the average temperature over time. This is due to adaptation.</p> <p>As the temperature decreases, health effects are seen. The phenomenon of excess winter mortality is largely related to temperature. Evidence in NZ (Christchurch) suggests that mortality increases when the temperature drops below 0°C.¹</p> <p>Commentary on how cold conditions affect health, is provided in the www.ehinz.ac.nz website and climate change factsheets.</p>
Methodology	<p>One weather station was used per TA, except for Auckland City (three weather stations were averaged). The weather station selected was based on proximity to the population-weighted centroid for that TA, and completeness of data for the period 2000-onwards.</p> <p>A population-weighted centroid is the geographical point corresponding to the ‘mid-point’ of the population. This allowed us to review the weather closest to where people live. The population-weighted centroid of a TA was calculated from the Census, using the geographic centroid of mesh blocks (a Census area description) weighted by their usual resident populations.</p> <p>Using the population-weighted centroid coordinates for each TA, we looked at weather stations within a 25km radius. The weather station in closest proximity 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). In some cases, no weather stations had complete data- usually one weather station was decommissioned and another started in a different site. In the case of incomplete station data, we have used the station but indicated where data are missing.</p> <p>In Auckland, we chose three dispersed weather stations (North Shore, Henderson and Mangere) due to the significant population size in comparison to the rest of the country. We averaged the data from the three stations to come up with a single Auckland Council value.</p> <p>Missing values were treated in the following way. If a weather station’s data included over 95% of the possible values for a particular year (i.e. 345 days), then a count of the number of days below 0°C was undertaken. If there were less than 345 days with a recorded maximum temperature, then no calculation was made and the year shows as ‘blank’.</p>

INDICATOR DATASHEET: NUMBER OF DAYS BELOW 0°C continued

<p>Use of measure</p>	<p>Monitoring the number of days in a year under 0°C allows us to determine whether the number of 'extreme' cold days is decreasing over time, as projected in climate change models. The measure is complementary to measuring the number of days over 25°C (which are projected to increase). Monitoring will be useful on a regional scale, because any climate changes, and their health impacts, are likely to vary in different areas of NZ.</p> <p>'Over time' in the context of these indicators means from the year 2000. This is not a sufficiently long period to determine 'climate change'. Users wanting evidence of 'climate change' in a meteorological sense should visit www.niwa.co.nz.</p> <p>We plan to continue to measure this indicator over time, which will enable better conclusions about how climate changes may be affecting health.</p>
<p>Limitations of the measure</p>	<p>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 1960-1990²; during this time, the effects of human-produced climate change are not thought to be apparent. The 2000-onwards data that we used did not have a sufficiently comparable 1960-1990 period, because weather station collection sites (and reliability) have changed over time.</p> <p>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.</p> <p>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).</p> <p>The use of population centroids will increase the risk of an 'urban heat island effect' 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.</p>
<p>Limitations of data sources</p>	<p>Some of the selected weather stations have missing data, usually due to starting collection after the year 2000.</p>
<p>Related Indicators</p>	<p>Number of days above 25°C Vulnerable populations indicators (extremes of age, Māori ethnicity, socioeconomic deprivation)</p>
<p>Recommendations for future development of indicator</p>	<p>Possible future indicators include heat and cold-related mortality, and heat and cold-related Emergency Department visits or hospitalisations.</p> <p>These data could be extended to produce modelled projections of extreme cold days and related illness/death in the future.</p>
<p>References</p>	<ol style="list-style-type: none"> 1. McMichael AJ, Woodruff R, Whetton P, et al. Human Health and Climate Change in Oceania: A Risk Assessment. In: Canberra: Commonwealth of Australia; 2002. 2. Chapter 13: Climate Scenario Development. In: Climate Change 2001: Working Group I: The Scientific Basis. GRID-Arendal, 2001. (Accessed June 4, 2014, at www.grida.no/publications/other/ipcc_tar.)