

INDICATOR DATASHEET: NUMBER OF DAYS OF SOIL MOISTURE DEFICIT

Type of Indicator	Weather Climate change
Definition and units	Annual number of days in soil moisture deficit (SMD). A day is in soil moisture deficit if the total soil moisture (calculated in millimetres from daily rainfall and evaporation) in the pasture plant root zone is less than 75mm . This equates to less than half of the soil moisture holding capacity which is set to 150 mm for all soils.
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 Authority (TA) regions
Temporal Scope	Calendar year, from 2000 onwards. Factsheet shows 2004-2013 average due to missing values prior to 2004.
Rationale	Climate change scientists project that NZ will spend an additional 10% of its time in drought by the mid-21st century. Drought can affect health in several ways– commentary on how dry conditions affect health, is provided on the www.ehinz.ac.nz website and climate change fact-sheets.
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 in SMD was undertaken. If there were less than 345 days with a recorded SMD, then no calculation was made and the year shows as ‘blank’.</p>

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<p>Use of measure</p>	<p>The indicator is best viewed in conjunction with a range of environmental health indicators, to see a more complete picture of environmental health in a changing climate. We know how health is affected by dry conditions, so monitoring the number of days of dry conditions will help us to see how severely health is affected. 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>There will be geographic variation in soil moisture across a TA that is not represented in this indicator because we have used one weather station per TA (except for Auckland).</p> <p>Drought is complex and can be defined in various ways. We have used the measure most commonly used to determine agricultural drought. However, a measure of hydrological drought is also relevant to health. Agricultural drought tends to be more severe than hydrological drought, so the indicator may underestimate dry conditions that can affect health.</p>
<p>Limitations of data sources</p>	<p>Counting the number of days exceeding a pre-determined deficit level has the effect of reducing a continuous variable (soil moisture) to a binary one (moisture less than 75mm). This gives a clear picture for an indicator purpose, but it also reduces the underlying data to use as an indicator only.</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 Incidence of cryptosporidiosis and giardiasis Vulnerable populations indicators (extremes of age, Māori ethnicity, socioeconomic deprivation)</p>
<p>Recommendations for future development of indicator</p>	<p>These data could be extended to produce modelled projections of drought and related illness/ in the future.</p> <p>A companion indicator of hydrological drought could be added.</p>