

Particulate matter concentrations (PM_{2.5})

This factsheet presents indicators of particulate matter (PM_{2.5}) concentrations at monitoring sites in New Zealand between 2008 and 2016. Concentrations are measured against two WHO guidelines for PM_{2.5} exposure (24-hour average and annual average).

Key facts



Eight monitoring stations exceeded the daily PM_{2.5} guideline on average 88 days per year between 2008 and 2016.



Almost three quarters of exceedances of the daily PM_{2.5} standard occur in the winter months.



Six out of eight monitoring stations exceeded the annual average guideline. Timaru exceeded the guideline the most, in five out of five monitored years.

What is particulate matter?

The most significant impacts on human health from air pollution are due to exposure to particulate matter (PM). PM can affect more people than any other pollutant and the relationship between health impacts and PM air pollution is therefore well researched (WHO 2013).

PM consists of small airborne particles, including solid matter and liquid droplets. PM_{2.5} refers to particles with a diameter of less than 2.5 micrometres. These particles are mainly produced by combustion of fossil fuels (eg. motor vehicle emissions, burning wood and coal for home heating) and through transformation of other particles such as NO_x, SO₂, and organics.

For information on PM₁₀ [Visit our website](#)

PM_{2.5} increases the risk of respiratory illnesses

Coarse particles such as PM₁₀ deposit in the upper airways, whereas small particles such as PM_{2.5} deposit in the very small airways deep in the lungs (Pope & Dockery 2006).

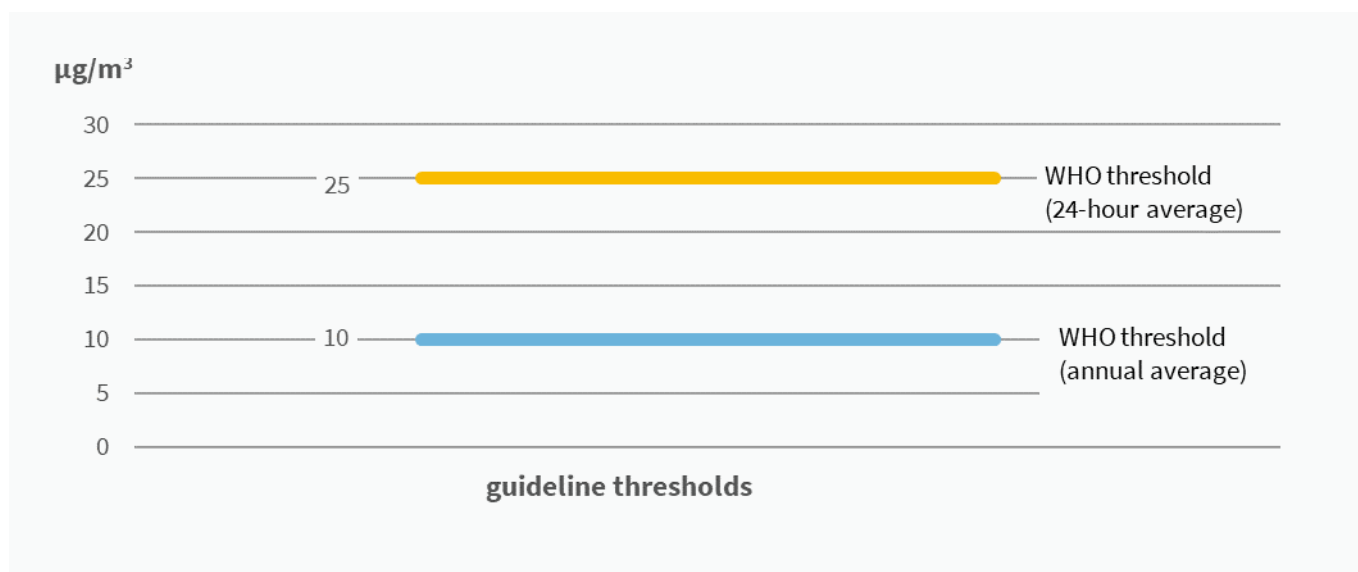
Short-term and long-term exposure to PM_{2.5} is associated with a wide range of health impacts. Mild impacts include shortness of breath or coughing. More severe impacts include premature death from cardiovascular and respiratory problems and an increased risk of lung cancer. Exposure to PM_{2.5} is also associated with asthma, diabetes and adverse birth outcomes such as low birth weight, preterm birth and small-for-gestational-age births (Ministry for the Environment and Stats NZ 2018; WHO 2013).

Infants, children, the elderly, and people with pre-existing conditions such as cardiovascular or respiratory diseases are particularly vulnerable to health impacts from PM_{2.5} air pollution (Ministry for the Environment and Stats NZ 2018).

PM_{2.5} air quality guidelines

At this time, New Zealand does not have a National Environmental Standard for Air Quality (NESAQ) for PM_{2.5}. International guidelines have been developed to provide some level of protection against health risks. However, currently there is no evidence for a safe threshold below which health effects do not occur (WHO 2013). Daily concentrations (24-hour average) are measured against a threshold value of 25 µg/m³ in the World Health Organization guidelines (WHO 2013). Annual average concentrations are compared against a 10 µg/m³ threshold (WHO 2013) (Figure 1).

Figure 1: PM_{2.5} guidelines (24-hour average and annual average)



Source: WHO 2013.

8 out of 35 monitoring sites had valid data between 2008 and 2016

Between 2008 and 2016, 8 out of 35 monitoring sites had valid data for PM_{2.5} exposure (Figure 2): three monitoring stations each in the Auckland and Canterbury regions and two monitoring stations in the Wellington region.

Figure 2: Monitoring stations with valid data, by region, 2008-2016



Source: Ministry for the Environment and Stats NZ 2018.

All eight monitoring stations exceeded the 24-hour average guideline

Between 2008 and 2016, all eight monitoring stations with valid data exceeded the WHO daily guideline ($25\mu\text{g}/\text{m}^3$ as a 24-hour average) (Figure 3). The guideline was exceeded on average 88-times per year (2008-2016). Timaru (Canterbury) exceeded the guideline the most, on average 62-times per monitored year (2012-2016).

Figure 3: Number of exceedances of the WHO guideline (24-hour average), at monitoring stations, 2008-2016



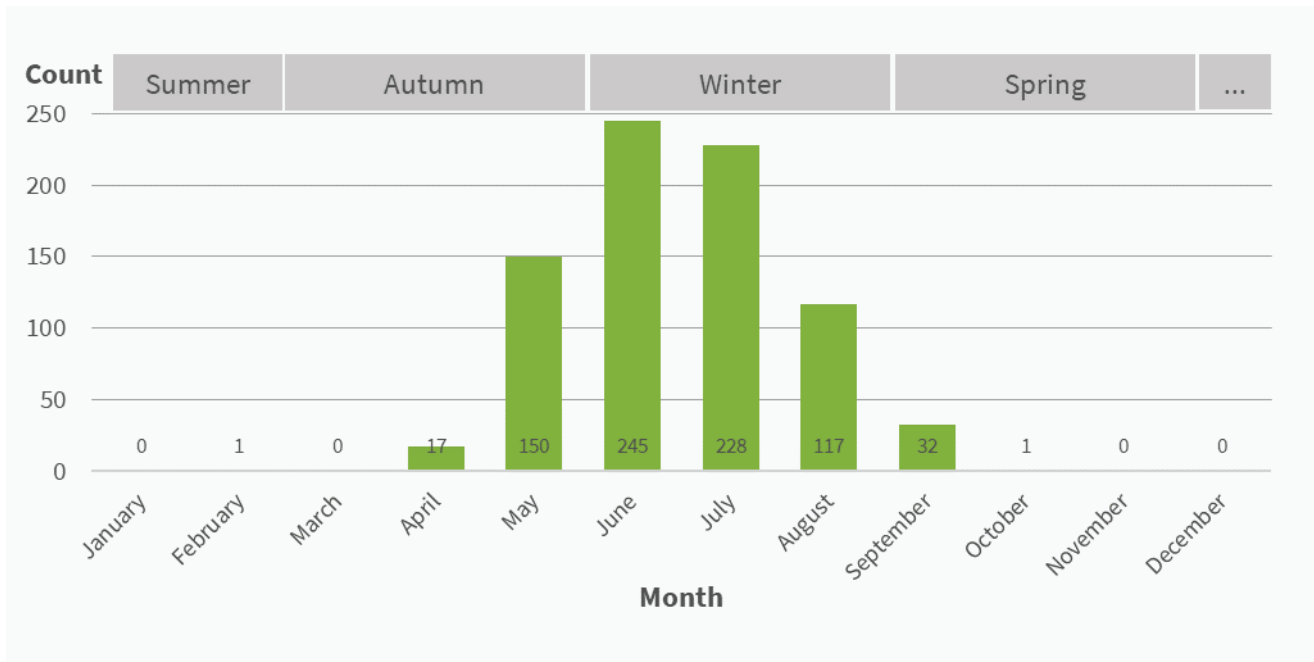
Note: WHO 24-hour threshold: $25\mu\text{g}/\text{m}^3$. Missing data labels are associated with no data for that year, ie. no monitoring data available or data not valid for that year.

Source: Ministry for the Environment and Stats NZ 2018.

Most exceedances occur in the colder months

Between 2008 and 2016, almost three quarters (590) of all exceedances of the 24-hour average threshold occurred in the winter months (June/July/August) (Figure 5). More than one fifth (167) of exceedances occurred in autumn (March/April/May). Most of the exceedances (95.7%) therefore happen in the colder months. During the cooler months, home heating emissions increase, contributing to worse PM_{2.5} concentrations and therefore exceedances. Furthermore, calm and frosty weather conditions in the winter months more easily allow for a build-up of air pollutants (Ministry for the Environment and Stats NZ 2018).

Figure 4: Number of exceedances of the WHO threshold (24-hour average) in New Zealand, by month, 2008-2016

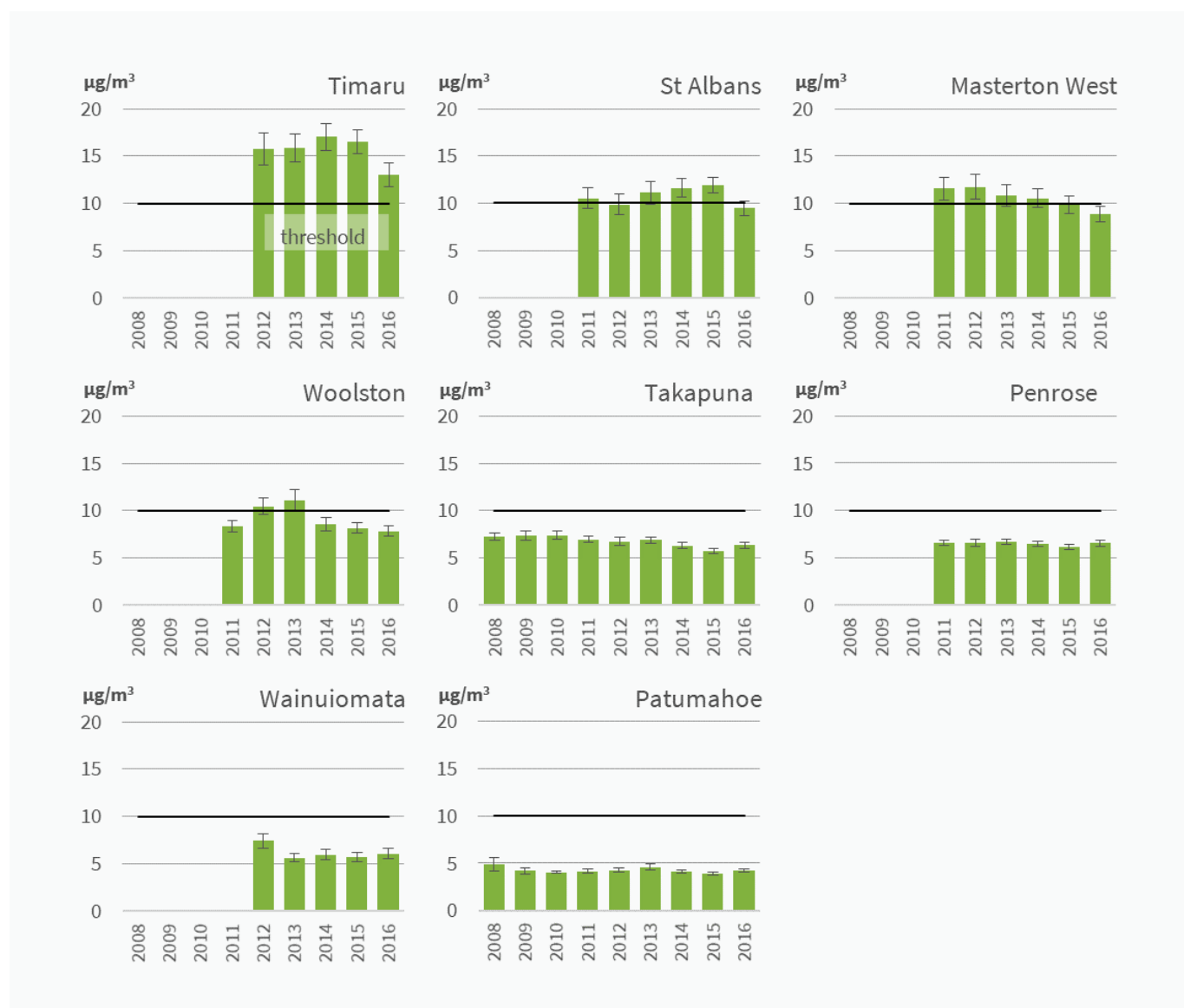


Note: WHO 24-hour threshold: 25µg/m³. Number of exceedances is the sum of eight monitoring stations.
Source: Ministry for the Environment and Stats NZ 2018.

The annual average WHO guideline was exceeded by four out of eight monitoring stations

Between 2008 and 2016, four out of eight monitoring stations exceeded the WHO annual average guideline. Timaru (Canterbury) exceeded the guideline the most: in five out of five monitored years (Figure 5). Takapuna (Auckland), Penrose (Auckland), Wainuiomata (Wellington), and Patumahoe (Auckland) did not exceed the guideline.

Figure 5: Annual average PM_{2.5} concentrations, at monitoring stations, 2008-2016



Note: WHO annual average threshold: 10µg/m³. Missing data labels are associated with no data for that year, ie. no monitoring data available or data not valid for that year.

Source: Ministry for the Environment and Stats NZ 2018.

Data for these indicators

95% confidence intervals have been presented as error bars on graphs. Unless otherwise stated, all differences mentioned in the text between two values are statistically significant at the 5% level or less.

Monitoring sites exceeding the WHO daily guideline (24-hour average) for PM_{2.5}

24-hour average PM_{2.5} concentration data comes from the Ministry for the Environment and Stats NZ (Ministry for the Environment and Stats NZ 2018) as part of New Zealand's Environmental Reporting Series. 24-hour average PM_{2.5} concentrations (in $\mu\text{g}/\text{m}^3$) are compared with the WHO guideline for PM_{2.5}. The threshold is exceeded when concentrations are above $25\mu\text{g}/\text{m}^3$. For additional information, see the metadata link below.

Monitoring sites exceeding the WHO annual average guideline for PM_{2.5}

24-hour average PM_{2.5} concentration data comes from the Ministry for the Environment and Stats NZ (Ministry for the Environment and Stats NZ 2018) as part of New Zealand's Environmental Reporting Series. Annual averages are calculated and compared with the WHO guideline for PM_{2.5}. Exceedances occur when concentrations are above $10\mu\text{g}/\text{m}^3$. For additional information, see the metadata link below.

References

Ministry for the Environment and Stats NZ. 2018. *Our air 2018. Data to 2017*. Wellington: Ministry for the Environment.

Pope CA & Dockery DW. 2006. Health effects of fine particulate air pollution: Lines that connect. *Journal of the Air & Waste Management Association* 56:709–42.

WHO. 2006. *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide. Global update 2005. Summary of risk assessment*. Geneva: World Health Organization.

WHO. 2013. *Review of evidence on health aspects of air pollution – REVIHAAP Project*. Copenhagen: WHO Regional Office for Europe.

Other related topics include:

[Wood and coal fires](#)

[Other air pollutants](#)

[Motor vehicles](#)

[Health effects of air pollution](#)

Author

The author of this factsheet is Carolin Haenfling ehinz@massey.ac.nz

Citation

Environmental Health Intelligence. 2020. *Particulate matter (PM_{2.5}) concentrations*. [Factsheet]. Wellington: Environmental Health Intelligence New Zealand, Massey University.

Further information

For descriptive information about the data:

Metadata Sheet for 24-hour average concentrations [Q Metadata Sheet](#)

and Metadata Sheet for annual average concentrations [Q Metadata Sheet](#)

[Q Visit our website](#)

[Subscribe to our newsletter](#)