

# workingpaper

## Evaluating the Atmosphere Dataset

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## **About the Resource Project Team**

The Resource Project Team comprises of Jessica Prendergast, Nicola Bradshaw, Chris Aitken, Lisa Bazalo, Jean-Charles Perquin, and Steph Versteeg. Each team member has placed a significant amount of time and effort into each Working Paper and the corresponding datasets

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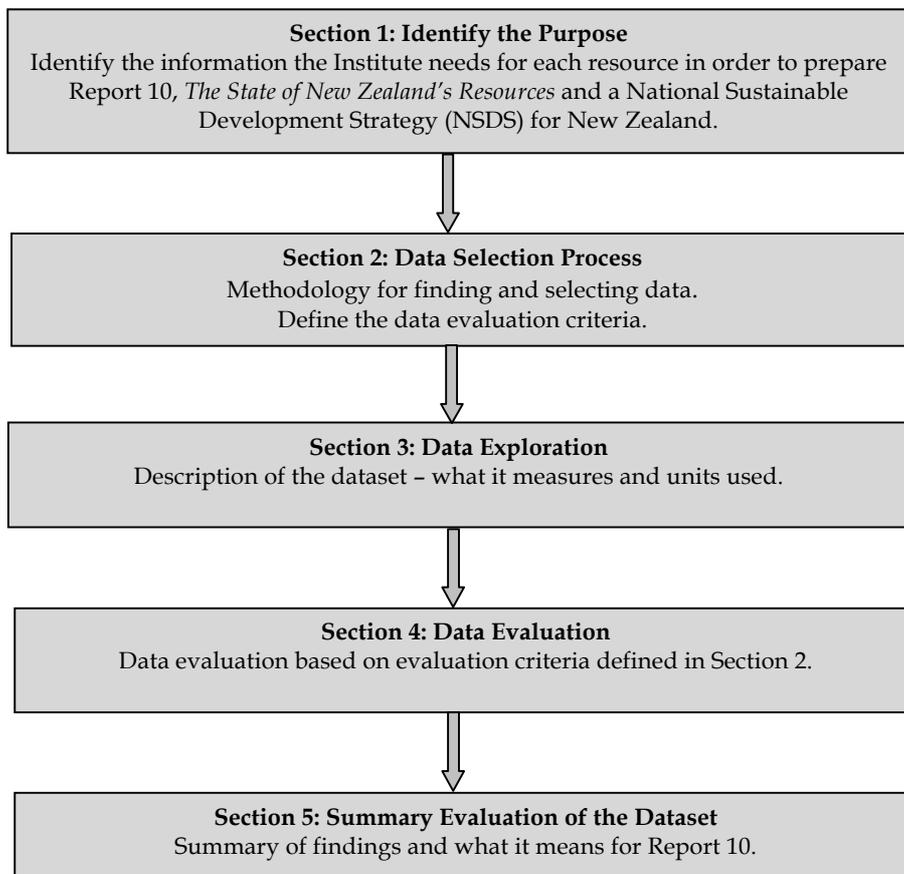
# 1. Purpose

This Working Paper is one of a series of 11 papers prepared as background to the Sustainable Future Institute's Report 10, *The State of New Zealand's Resources* (SFI, in press). Report 10 aims to provide an overview of available data and information covering a range of resources, and to discuss the use, availability and appropriateness of the data in the preparation of a National Sustainable Development Strategy (NSDS).

The purpose of this Working Paper is to describe the process by which the Institute collected, collated and presented a selection of data on New Zealand's atmosphere. The datasets are summarised and evaluated for completeness, accuracy, relevance, appropriateness of sources and public availability. This paper also discusses the purpose for which the data was collected by its custodians, and why the Institute has selected this data for its reporting. The content of the dataset is not interpreted or analysed; rather, our purpose is to evaluate the usefulness of this dataset for the purposes of Report 10.

Following this evaluation any gaps and resulting limitations in using the selected data are assessed, as well as its relevance and reliability in relation to the Institute's purpose of using the comprehensive series of datasets to inform the development of an NSDS for New Zealand.

**Figure 1 The Five-step Process for Evaluating the Institute's Datasets**



## 1.1 The Sustainable Future Institute

The Institute is an independently funded think tank based in Wellington, New Zealand. Earlier work by the Institute has indicated that New Zealand is well behind other developed countries on its international obligations to develop and implement a National Sustainable Development Strategy (NSDS) (SFI, 2007). It is hoped that *Project 2058* will help inform ministers, policy analysts and members of the public about key events and trends in New Zealand's past, and alternative strategies for the future. With this in mind, this Working Paper is a step towards the Institute's goal of preparing an NSDS for New Zealand in 2011.

## 1.2 Project 2058

The strategic aim of *Project 2058* is to promote integrated long-term thinking, leadership and capacity building so that Aotearoa/New Zealand can effectively seek and create opportunities, and explore and manage risks, over the next 50 years. In order to achieve this aim, the *Project 2058* team is working to:

1. Develop a detailed understanding of the current national planning landscape, and in particular the government's ability to deliver long-term strategic thinking;
2. Develop a good working relationship with all parties that are working for and thinking about the 'long-term view';
3. Recognise the goals of iwi and hapū, and acknowledge te Tiriti o Waitangi;
4. Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future, such as government-funded science, natural and human-generated resources, the state sector and infrastructure;
5. Develop a set of four scenarios to explore and map possible futures;
6. Identify and analyse both New Zealand's future strengths and weaknesses, and potential international opportunities and threats;
7. Develop and describe a desirable sustainable future in detail, and
8. Prepare a *Project 2058* National Sustainable Development Strategy. (SFI, 2009: 3)

The culmination of *Project 2058*, the creation of an NSDS, depends on having an accurate assessment of key aspects of New Zealand society. Earlier reports have dealt in particular with points 1, 3, 5 and 6 above,<sup>1</sup> and this Working Paper is designed to help progress the fourth point: 'Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future ...'

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<sup>1</sup> For a detailed list of published and upcoming reports, see *Project 2058 Methodology: Version 3* (SFI, 2009: 7).

### 1.3 Atmosphere Resources within an NSDS

Below we ask six strategic questions that drive this research. These are then expanded upon to discuss the use, availability and appropriateness of the data in the preparation of an NSDS. Without accurate, comprehensive, relevant and accessible data to answer the following questions, it will be difficult to develop and execute an informed NSDS for New Zealand.

- **What** are the issues facing the atmosphere in New Zealand? Are New Zealanders clear on exactly what these issues are? Does New Zealand have quality data and information to enable us to understand these issues as fully as possible? Are New Zealanders able to establish an informed understanding of the priorities?
- **Why** does New Zealand need to confront issues affecting our atmosphere? Are there improvements that can be achieved; or practices that need to change? Are current indicators relevant and meaningful to benchmark changes over-time? What is the purpose and the benefit in taking action?
- **When** should New Zealand start to address issues which impact on New Zealand's atmosphere? Is now the right time? Are current economic, social and environmental conditions conducive? Would it be beneficial to wait and monitor events as they evolve? Are current measures and indicators appropriate to monitor developments? Is there a risk of rushing into short-term action when a long-term approach is needed?
- **Where** do New Zealanders most need to concentrate their efforts to address issues facing New Zealand's atmosphere? Which aspects of the issue should be focused on first? Where should New Zealanders begin to ensure the most beneficial and sustainable outcome? Does New Zealand have sufficient knowledge, based on accurate and appropriate data, to assess outcomes?
- **Who** must be engaged to effectively address issues facing the atmosphere in New Zealand? Who needs to be involved if New Zealand is going to successfully tackle these issues? Is data on the atmosphere in New Zealand accessible and transparent to allow those interested to be accurately informed? Are data ownership issues affecting public involvement?
- **How** should New Zealand ensure we have effective management of our atmosphere? What is the best approach? What skills or techniques are needed? Does New Zealand have comprehensive and accurate information to enable effective management? How can New Zealand learn from international experience to assist in the maintenance and protection of our atmosphere?

This working paper does not attempt to answer the above overarching questions. These overarching questions do however inform our purpose for Report 10 and in progressing an NSDS. Data collected for inclusion within the Institute's dataset has enabled us to understand the level of accuracy, relevance, comprehensiveness and issues of ownership that exist surrounding publicly available data in New Zealand. The above questions function as a

bridge between the dataset, this Working Paper and Report 10; specific questions pertaining to how the selected Institute's dataset will inform the development of an NSDS are outlined in Table 1.

## 2. Data Selection Process

### 2.1 Methodology

Report 10a, *Designing a Framework to Monitor New Zealand's Resources* (SFI, 2010) outlined the process through which the Institute developed the framework for collecting and presenting the data. With this framework in place, the steps towards the completion of Report 10 are: (i) building the datasets for the 11 resource types studied; (ii) evaluating the selected datasets, and (iii) reporting on the findings in relation to the Institute's aim of defining an NSDS for New Zealand. The datasets developed in Step (i) are available on our website.<sup>2</sup> This Working Paper is one of 11 that form Step (ii), the data evaluation. Step (iii) will be published in Report 10.

The source data for the Institute's Atmosphere Dataset was reproduced from a variety of static tables extracted from the Ministry for the Environment's (MfE) website. The tables used are listed on the Institute's website under Project 2058 Publications and State of New Zealand's Resources. The Institute has taken the original data and reformatted it in Excel spreadsheets to facilitate use and analysis. The original data values have been preserved.

### 2.2 Sources of Data

The Institute supports the free availability of data relating to environmental statistics. With this in mind, we deliberately only used openly accessible data so that we were able to report on its availability and identify potential gaps. This enables us to report on the implications of using only freely available data, and to evaluate the information that can be extracted from these data sources.

We acknowledge that many sources of information exist on New Zealand's air quality that may or may not be publicly available or easily discoverable. Crown Research Institutes (CRIs), universities, national and local government, and other private and public organisations may also hold data on air quality.

For various reasons including privacy, commercial sensitivity, cost of dissemination or commercial sale price of the data, there are many datasets on New Zealand's resources that are inaccessible to the public. Without extensive research, funding or expertise to assist in the interpretation of the data, many others remain unavailable. The Institute has focused on open data; therefore no efforts have been made to retrieve the other datasets. This is a limitation of this project as gaps identified by the Institute could potentially be filled by these other data sources.

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<sup>2</sup> [www.sustainablefuture.info](http://www.sustainablefuture.info)

The Institute searched for and compiled the Atmosphere Dataset in 2009. What we have selected and discussed in this Working Paper reflects data fitting our purpose within the environmental data landscape at the time of research.

As data availability increases rapidly on an ongoing basis, it would not be practical to include within this Working Paper all datasets relevant to atmosphere in New Zealand. Report 10 investigates the past, present and future of the environmental data landscape in New Zealand. It also provides a list of alternative sources of information pertaining to New Zealand resources. When appropriate, we have mentioned complimentary data sources in this Working Paper.

Data on New Zealand resources is often produced and targeted to industry experts. This makes a thorough analysis and evaluation of the datasets a complex task for the uninitiated. We have referred to the original source documents to support our evaluation of the datasets.

### 2.3 Atmosphere Dataset Evaluation Criteria

The Institute has developed a series of criteria to support the effective evaluation of its datasets and to consider the data in the context of our wider work programme. Each criterion is supplemented with questions to direct attention to relevant areas for consideration. The aim is to structure the analysis of each dataset in a way that is consistent and replicable across the 11 datasets. In this Working Paper, these criteria are applied to the Atmosphere Dataset as a whole and to the different indicators and sources that comprise the dataset.

The criteria and guiding questions are outlined in Table 1 below.

Table 1 Criteria for Evaluating the Institute's Datasets

Criteria for evaluation	Guiding questions
Comprehensive time series	For how long has the data been collected? Are there gaps in the records? Are data/indicators consistent and comparable over time?
Quality data	What is the scope and range of indicators; are there any gaps? Is data comprehensive and detailed? How is the data classified/categorised? Is the data local/regional/national? Is the data internationally comparable and valid? Is the data accurate – is there any sampling bias? Are error bars calculated? Is the data relevant and able to be interpreted with meaning?
Appropriate sources	How many sources are drawn on, and what are they? Who owns the data?

## 2. Data Selection Process

	<p>Why, how and where is data collected/measured?</p> <p>Is it original data, self-reported/obtained by survey?</p> <p>Is the data collection and analysis informed by sound assumptions?</p> <p>Is data reliable, independent, verifiable and/or of international standard?</p> <p>Is the data subject to (external) review?</p>
Publicly available	<p>Is the data easy to access?</p> <p>Is the data located online, in publicly available reports or databases, or within an institution?</p> <p>Is it freely available?</p>

### 2.4 Selected Sources

In order to find possible sources of data to establish a baseline portrait of the state of New Zealand's atmosphere, the Institute searched the websites of agencies and organisations with relevant links to New Zealand's atmosphere, air quality and emissions and management. A search was undertaken to find online datasets and statistics, documentation on the data collection and its uses, and specific publications on air and atmosphere, as well as general publications such as annual reports.

#### Air quality

Air quality is defined by the National Aeronautics and Space Administration (NASA) as 'a measure of the degree to which air is free from harmful pollution' (NASA, n.d.). Data on this measure was collected from the MfE website, where it is updated annually and available under the section on environmental reporting on air and atmosphere. Information is gathered from regional and unitary authorities which monitor airsheds' PM<sub>10</sub> measurements within their jurisdiction and provide their information to the Ministry (MfE, 2008a).

#### Greenhouse gas emissions and removals

Greenhouse gas emissions and removals data for the Institute's Atmosphere Dataset was obtained from New Zealand's *Greenhouse Gas Inventory 1990–2007* (MfE, 2009a), which is updated annually. The national inventory presents trends in New Zealand's emissions profile, provides both an overview and a detailed analysis of emission levels and trends in each sector, and provides considerable insight into the collection and use of data for the inventory. The Institute chose to use this data as it provides a high-level overview of New Zealand's current emissions profile and trends since 1990.

The NZNIR (National Inventory Report) contains data covering New Zealand's anthropogenic emissions and inventorised carbon sinks and is a part of New Zealand's governmental obligations to the United Nations Framework Convention on Climate Change (UNFCCC). These inventory data give you New Zealand's (small contribution) to global emissions of greenhouse gases and are not indicators for what our current or future atmospheric composition of greenhouse gases is or will be.

The United Nations Framework Convention on Climate Change (UNFCCC) and the resulting Kyoto Protocol is an international policy approach designed to mitigate and adapt to climate change in developed, transitioning and developing countries. The collection and reporting of data on national gross greenhouse gas emissions by sector, gas/source, and net removals is required under the 1992 UNFCCC and the Kyoto Protocol (MfE, 2009a). Since ratifying the Kyoto Protocol on December 19, 2002, New Zealand has submitted annual national emissions inventories. This process also forms a part of the government's state of the environment reporting (ibid.). This information is all freely available on the MfE website.

The Ministry for the Environment leads a whole-of-government process to produce each national emissions inventory, also known as a net position report, for the Minister Responsible for Climate Change Issues. Several other government departments, including the Ministry of Economic Development, Ministry of Agriculture and Forestry, Treasury, Ministry of Transport and the Department of Conservation as well as Crown Research Institutes such as AgResearch and independent researchers also provide input to this cross-government programme. Data presented on greenhouse gas emissions and removals on the Institute's Dataset is also sourced from these other official bodies.

#### **Data not used**

The Institute was unable to access raw data for stratospheric ozone levels, despite the reporting on these levels in the Ministry for the Environment's *State of the Environment 2007* report (MfE, 2007). Concentrations of stratospheric ozone over New Zealand have been consistently measured since 1970 (ibid: 203), and this indicator is representative of the condition of the ozone layer over mid-latitudes in the southern hemisphere (ibid: 189). However, we have not included these figures in our framework because the underlying data is not readily publicly available. The data in *State of the Environment 2007* is sourced from the National Institute of Water and Atmospheric Research (NIWA), a Crown Research Institute (ibid: 203–205).

#### **PM<sub>10</sub> particulate levels**

Within the Institute's dataset we have only used PM<sub>10</sub> particulate levels data as a measure of air quality. The data used represents annual peak concentrations of PM<sub>10</sub> for one selected airshed within each authority's boundaries. We do not include data on nitrogen dioxide, carbon monoxide, sulphur dioxide and tropospheric ozone, though such data may be incorporated at a later date. These indicators provide a less comprehensive coverage of airsheds, as they have not been monitored continuously over a long duration or are outside of main centres (MfE, 2007: 165–176).

Other measures of PM<sub>10</sub>, such as data measuring the acceptable annual average PM<sub>10</sub> level, have not been used in our dataset. This level was set at 20  $\mu\text{g}\cdot\text{m}^{-3}$  in the national ambient air quality guidelines which were established and updated in 2002 (MfE, 2002; 2009b).

## **2.5 Additional Resources**

The Institute's 11 working papers, prepared as background papers to Report 10, *The State of New Zealand's Resources*, are selective in their use of specific information and data from within

## 2. Data Selection Process

a broader pool of information. The boundaries set for these working papers were tightly focused on openly accessible online data available as at February 2010, the original time of data collection for the Institute's accompanying datasets. For further reading and comparisons which fall outside of our collection strategies we suggest the following additional sources. Please note that the findings of these reports have not been included within this working paper due to the reasons outlined above, but that references to these additional sources are included in the reference list at the back of this paper.

### **Greenhouse Gas Data**

The following global data centre repositories contain New Zealand Greenhouse Gas data:

#### **The World Data Centre for Greenhouse Gases (WDCGG)**

WDCGG is one of the WDCs under the Global Atmosphere Watch (GAW) programme. It serves to gather, archive and provide data on greenhouse gases and related gases in the atmosphere and ocean, as observed under GAW and other programmes (WDCGG, n.d.[a]).

#### **Global Atmospheric Watch Station Information System (GAWSIS)**

GAWSIS is being developed and maintained by Quality Assurance/Scientific Activity Centre (QA/SAC) Switzerland in collaboration with the World Meteorological Association Global Atmosphere Watch (WMO GAW) Secretariat, the GAW World Data Centres and other GAW representatives to improve the management of information about the GAW network of ground-based stations. Their goal is to provide the GAW community and other interested people with an up-to-date, searchable database of: site descriptions, measurements programs and data available, contact people and they hold metadata on New Zealand stations (GAWSIS, n.d).

#### **The National Institute of Water & Atmospheric Research (NIWA)**

NIWA is a Crown Research Institute (CRI) whose mission is to conduct leading environmental science to enable the sustainable management of natural resources for New Zealand, and is the lead CRI in climate and atmosphere. NIWA provides online access to major climate and environmental monitoring systems and forecasting tools. Their information pages include *Greenhouse Gas Measurements* (NIWA, n.d.[a]) and *Publicly Available Data and Publications* (NIWA, n.d.[b]).

### **Atmospheric Data**

The following global data centre repository contains atmospheric data for the New Zealand ozone:

#### **The World Ozone and Ultraviolet Radiation Data Centre (WOUDC)**

WOUDC is one of the World Data Centres which are part of the Global Atmosphere Watch (GAW) programme of the World Meteorological Organization (WMO). Their website contains *Column ozone plots* (WOUDC n.d.[b]) and the *WOUDC Total ozone directory* (WOUDC, n.d.[c]).

Further, for background reading on the science, see NIWA's information page *UV & Ozone* on atmospheric ozone and UV radiation (NIWA, n.d.[c]).

### 3. Data Exploration

For the purpose of this research, atmosphere has been defined as:

the mixture of gases that surrounds the Earth and some other planets. The concentrations of the gaseous constituents of Earth's atmosphere are determined by biogeochemical processes, including manmade effects (NASA, n.d.).

In the Institute's framework for monitoring New Zealand's resources, atmosphere has been categorised as a Whole System Resource, which comprises three key aspects: (i) air quality; (ii) greenhouse gas emissions and removals; and (iii) stratospheric ozone levels (SFI, 2010).

A comprehensive understanding of the state of and trends in New Zealand's atmospheric resource is vital for planning for the future. To help achieve this understanding, three categories have been investigated within the Atmosphere Dataset. The selected metadata is summarised in Table 2: (a) air quality; (b) greenhouse gas emissions and removals; and (c) stratospheric ozone levels. As noted above, however, the lack of publicly available data relating to ozone levels meant that the Institute was unable to include it in the dataset.

**Table 2 Atmosphere Dataset Summary Table**

Source: SFI, 2010b

Dataset Category	Data Custodian	Data Presented	Dates	Measures	Data Reporting Frequency	
Air Quality	Regional councils and unitary authorities. Data collated and presented by MfE.	Particulate matter (PM <sub>10</sub> )	2005–2008	Micrograms per cubic metre (µg <sub>m</sub> <sup>-3</sup> )	Annual 24-hour peak concentration in a selected airshed within each authority	
		Nitrogen dioxide	N/A	N/A		
		Carbon monoxide				
		Sulphur dioxide				
		Tropospheric ozone				
Greenhouse gas emissions & removals	Ministry for the Environment	Emissions by pollutant/gas	Carbon dioxide	1990–2007	Megatonnes of carbon dioxide equivalent (Mt CO <sub>2</sub> -e)	Annual
			Methane			
			Nitrous oxide			
			Sulphur hexafluoride, hydrofluorocarbons, perfluorocarbons			
		Emissions by sector	Energy			
			Industrial processes			
			Waste			
			Agriculture			

### 3. Data Exploration

		Total net removals			
<b>Stratospheric ozone</b>	NIWA	N/A	N/A	N/A	N/A

#### Air quality

In 2004 a National Environmental Standard (NES) for air quality was introduced (MfE, 2008b), under which particulate matter (PM<sub>10</sub>) has an acceptable daily peak level of 50 µg.m<sup>-3</sup>.

Nationwide, particulate matter is measured in 68 airsheds, which comprise approximately 1.5% of New Zealand's land area and two-thirds of the country's population. Population size, geography, weather patterns and local emissions are taken into account when identifying airsheds that are likely or known to breach national environmental standards. If initial recordings show that PM<sub>10</sub> levels are above the standard or that a large number of people may be affected, ongoing monitoring takes place (MfE, 2009f: 3). In 2009, 44 of these airsheds were being continuously monitored (MfE, 2009d).

In some cases, such as Gisborne District Council, no continuous monitoring of particulate matter has been provided to MfE during the 2005–2008 period, although sampling monitoring has revealed PM<sub>10</sub> levels in Gisborne are below the standard. With the exception of Taranaki, all other regional authorities have at least one monitored airshed within their boundaries. Environment Waikato has the highest quantity of monitored airsheds (8), and the most listed but not monitored (19). Where more than one airshed is monitored in each area, data from just one was included in the Institute's dataset. Figure 2 shows an excerpt from the air quality dataset.

**Figure 2 Excerpt from the Air Quality Dataset**

Source: SFI, 2010b

Attribute		2005	2006	2007	2008	Data source table #
PM <sub>10</sub>	Northland-Whangarei	47.00	52.00	38.00	35.00	9a
	Auckland	86.00	65.00	137.00	64.00	
	Environment Waikato-Hamilton	40.00	75.00	46.00	48.00	
	Environment Bay of Plenty- Rotorua	47.00	116.00	111.00	162.00	
	Gisborne	..	..	..	..	
	Hawke's Bay-Napier	67.00	72.00	86.00	64.00	
	Taranaki	..	..	..	..	
	Horizons-Taihape	..	44.00	40.00	42.00	
	Greater Wellington-Wellington	30.00	37.00	27.00	60.00	
	<b>North Island avg</b>	<b>52.83</b>	<b>65.86</b>	<b>69.29</b>	<b>67.86</b>	

#### Greenhouse gas emissions and removals

For greenhouse gases, it is the amount of the emissions that remain in the atmosphere that determines the magnitude of present and future greenhouse effect and consequential global warming. The main three anthropogenic greenhouse gases are carbon dioxide, methane and nitrous oxide. Carbon Dioxide is particularly long-lived and a proportion of today's emissions will still be around 1000 years hence. Reported data represents megatonnes (million tonnes) of carbon dioxide equivalent (Mt CO<sub>2</sub>-e) greenhouse gases per year. Sources

of emissions are broken down firstly into type, and then sector. The data also includes total net removals, by Mt CO<sub>2</sub>-e. The Institute's dataset reports data from 1990 to 2007, drawing on the 2007 greenhouse gas inventory, published in 2009 (MfE, 2009a). Figure 3 shows an excerpt from the Institute's greenhouse gas emissions and removal dataset. Data between 1990 and 2007 has been omitted for representation purposes.

**Figure 3** Excerpt from the Greenhouse Gas Emissions and Removal Dataset

Source: SFI, 2010b

Indicator	Attribute		1990	2007	Data source table #
9.2 Greenhouse gas emissions & removals	emissions	carbon dioxide	25.30	35.20	9f
		methane	25.40	26.60	
		nitrous oxide	10.40	12.80	
		sulphur hexafluorine, hydrofluorocarbons, perfluorocarbons	0.70	0.90	
		<b>total emissions</b>	<b>61.80</b>	<b>75.50</b>	
	emissions by sector	energy	23.50	32.70	9h
		industrial processes	3.40	4.60	
		waste	2.40	1.80	
		agriculture	32.50	36.40	
	removals	<b>total net removals</b>	<b>-18.10</b>	<b>-23.80</b>	9g

### Stratospheric ozone

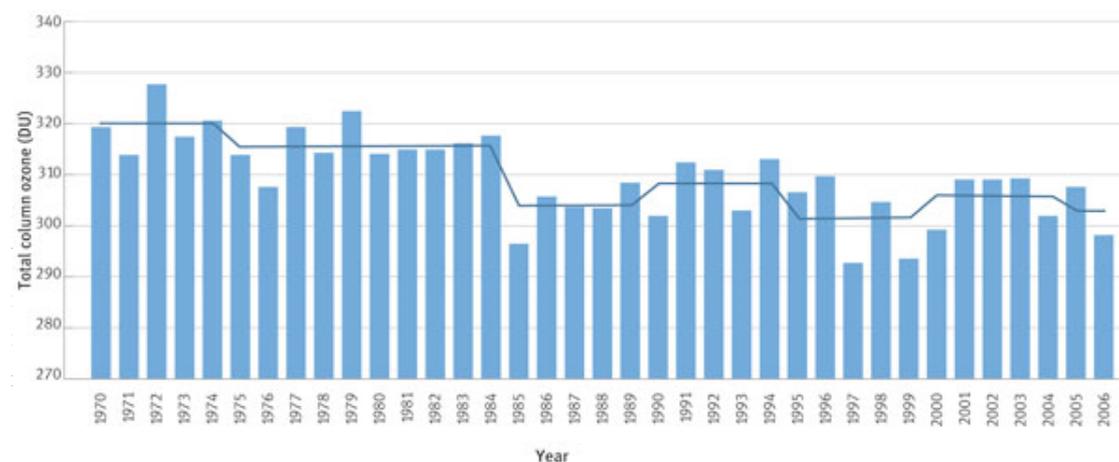
Stratospheric ozone levels have not been included in our dataset, although information on ozone levels is reported; as the underlying data is not publicly available on the internet.

Figure 4 is an example of how MfE has presented data on stratospheric ozone levels.

This graph displays ozone concentration measurements over New Zealand from 1970 until 2006 (MfE, 2007: 205).

**Figure 4** Average Yearly Ozone Levels over New Zealand, 1970–2006

Source: MfE, 2007: 203



## 4. Data Evaluation

### 4.1 Comprehensive Time Series

#### **Air quality data recorded since 2005 for most regional councils, but not all airsheds monitored**

Regional and unitary authorities have provided data on PM<sub>10</sub> levels to MfE since 2005, representing a range of airsheds. The purpose of this data collection is to measure compliance with the National Environmental Standard. However, it is too soon to measure trends, since the data has been gathered over a limited period of time, and monitoring data for all airsheds since 2005 does not exist.

#### **Greenhouse gas emissions and removals recorded from 1990 to the present year**

New Zealand became party to the UNFCCC in 1992, and has reported annually on its greenhouse gas emissions since 1990, in order to fulfil the requirements of the convention (MfE, n.d.). This duration of reporting provides useful data for measuring greenhouse gas emissions and the progress New Zealand is making towards the goal of reducing emissions to 1990 levels by 2012.

### 4.2 Quality Data

#### **Comparability of collection methods of air quality data between each airshed**

Data is obtained by regional authorities and made publicly available by MfE. The Ministry also provides information on data collection methods in each airshed, and the percentage of data collected which was valid (MfE, 2008a). A margin of error is not presented for this data. Based on the available information, it is difficult to know how comparable data readings from different sites are, taking into account varying methods of collection and other sources of error, however all sites use methods outlined by MfE.

#### **Air quality data selected for one airshed per regional council**

The Institute has selected data that represents annual peak concentrations of PM<sub>10</sub> for one selected airshed within each authority's boundaries. The decision to select one airshed per authority was made for practical reasons and to provide an overview of air quality in each region. We recognise that the exclusion of data relating to other airsheds limits the comprehensiveness of data and its usefulness in describing more specific areas or localities.

#### **National Environmental Standard for air quality comparable to World Health Organisation standard**

The National Environmental Standard for air quality is equivalent to the World Health Organization's (WHO) air quality guideline for 24-hour average peak concentrations (WHO, 2006: 9). The WHO document sets the annual mean and peak daily mean figures together – the basis for setting the daily mean is the relationship it has to annual mean levels (ibid.). This suggests that it is important to consider these two records together.

### Reliance on particulate matter as sole indicator for air quality

The data we have collected on particulate matter represents a key indicator of air quality. The purpose of the indicator is to provide up-to-date information and it is not a long-term indicator of air quality. It is currently the most widely and consistently collected indicator, and provides a representation of air quality and relevant trends in more densely populated centres in New Zealand. This indicator is site-specific, arising from a combination of localised human activities (such as burning solid fuel for home-heating and road transport pollution) and natural factors (such as weather and geography) (MfE, 2007: 148–149).

However, drawing on only one indicator of PM<sub>10</sub> does not provide enough information to draw conclusions about air quality in a particular airshed. Data this indicator provides is not representative of the overall air quality in the region. For example, there is little relationship between 24-hour peak level and the number of times the standard is exceeded annually (MfE, 2009b). Therefore, links between health effects and peak concentrations of PM<sub>10</sub> is at best tenuous and this indicator of PM<sub>10</sub> does not provide sufficient information to properly measure, on a national scale, the health impacts of poor air quality (ibid.). Public health implications are covered in greater depth in, for example, the environmental health indicators on the Public Health Surveillance website, which is run by the Institute of Environmental Science and Research Ltd (ESR), under contract to the Ministry of Health (ESR, n.d.), and other MfE webpages.

Comprehensive data for air quality indicators other than PM<sub>10</sub> annual average of 24-hour peak level was not publicly available on the internet. It would be useful to access different air quality indicators for each airshed in order to build more complete profiles of air quality.

The following details MfE's interpretation of the limitations of the air quality standards and the limitations of the data being collected on five key pollutants (MfE, 2009e).

The key limitations of the environmental indicator of air quality are:

- The indicator covers only the five key outdoor air pollutants of national significance. In addition, it does not include indoor air pollution.
- The indicator is primarily focused on tracking air quality against the national environmental standard. Although localised studies on air quality are able to provide more detailed information on the human health effects of air pollution, this indicator does not report on or quantify the specific human health effects of poor air quality at the national scale.
- The indicator does not show the effects from exposure to two or more air pollutants in the environment. This is relevant because most combustion processes give rise to several pollutants simultaneously.
- The indicator reports on the state of air quality over time, but does not allow for the influence of variations in weather and climate from year to year. This makes it difficult to assess whether changes in air quality are caused by changing environmental pressures – for example, a reduction in the emission of air pollutants – or weather variations, such as changes in wind patterns.
- Before the introduction of the ambient standards in 2005, many locations had little or no nationally comparable monitoring that provided data for long-term trends of air quality.

##### **Greenhouse gas emissions and removals methodologies provided by the IPCC and UNFCCC**

The International Panel on Climate Change (IPCC) and the UNFCCC provide the methodologies and guidelines for measuring emissions and calculating data for *New Zealand's Greenhouse Gas Inventory*. Methodologies, quality assurance and control, analysis of uncertainty and completeness are all provided in annexes to the main inventory report. As long as New Zealand's methodology and quality of analysis are in line with the international standard, then there is a high degree of comparability between New Zealand's inventory and those of other countries.

##### **Values for greenhouse gases recalculated when methodologies are revised**

It should be noted that when methodologies are revised or there are new data requirements, the complete data time series is recalculated, which means that data will then differ from that reported in previous year's inventories (MfE, 2009a: 136). Therefore, figures may not always be directly comparable between inventories. However, each year's inventory figures provide data which is time series consistent and therefore indicative of relative trends over the period.

### **4.3 Appropriate Sources**

#### **Regional authorities' air quality data**

Original sources of this data were the regional authorities, which provided the data to MfE as part of their obligation to report on their progress towards meeting the National Environment Standard (NES) for air quality.

#### **International review of greenhouse gases inventories**

Each greenhouse gas inventory that is submitted to the UNFCCC must then undergo international review to ensure the reporting is of the quality required under the Climate Change Convention and the Kyoto Protocol (MfE, 2009a: 4).

#### **Ensuring ongoing air quality compliance**

The daily peak level set for PM<sub>10</sub> is 50 micrograms per cubic metre ( $\mu\text{g}\cdot\text{m}^{-3}$ ). To comply with the standard, this level may not be exceeded on more than one day each year. By 2013, regional councils must meet this national air quality standard. After 2013, resource consents for discharge to air cannot be granted in airsheds that do not comply with the standard (MfE, 2009b). PM<sub>10</sub> particles present a concern at higher levels as they are readily inhaled and absorbed into the lungs.

## 4.4 Public Availability

### All data publicly available and well documented

It is the aim of this project to assess publicly available data, i.e. data that is able to be accessed by parties independent of those who collect or present it. MfE's reports fit this criterion; the reports are freely available to the public via the agency's website, with the exclusion of the air quality data for 2005 and 2006 which was not available online at the time of publication, as mentioned in detail below.

Of note, the long-term atmospheric measurements in New Zealand are part of an internationally co-ordinated and intercalibrated effort which is needed to assess the state of the global atmosphere. Atmospheric measurement data is particularly sparse in the Southern hemisphere and hence New Zealand's measurements are especially important. Typically the quality controlled data from this work is available through the relevant international databases (as specified in Section 2.5). However, from an industry perspective it is not the data alone that is important but what it indicates to organisations like NIWA and the international community involved in its analysis and interpretation. This work is recorded in scientific peer reviewed literature, contributions to the Intergovernmental Panel on Climate Change (IPCC) reports and locally through workshops, conferences, websites and other outreach activity where the industry communicates their advances in understanding.

### Ministry for the Environment as a central point of air quality source data

MfE was the Institute's point of contact for accessing this data. MfE's datasets compiled information from different sources into a concise inventory. Significant quantities of information about the NES, particulate matter and air quality are available on the Ministry's website, although as at February 2010, the original time of data collection, the 2005 and 2006 data in our dataset was not directly available online. Following a request to ministry staff this data was readily provided.

### Greenhouse gas emissions and removals also published by MfE and supported by the UNFCCC website

All national emission inventories and required international reporting documents are available on the MfE website, which provides a high level of transparency and accountability. The website of the UNFCCC also has a high level of transparency with regard to supporting data such as methodologies for conducting inventories and the review process.

## 5. Evaluation of the Dataset

The Institute chose MfE published statistics to inform its upcoming Report 10 and an NSDS, as these sources are deemed to be comprehensiveness and reliable. However, the Institute's dataset has limitations, specifically in regards to the lack of information on other air quality pollutants and access to raw data on stratospheric ozone levels. Table 3 below summarises the Institute's evaluation of the Atmosphere Dataset.

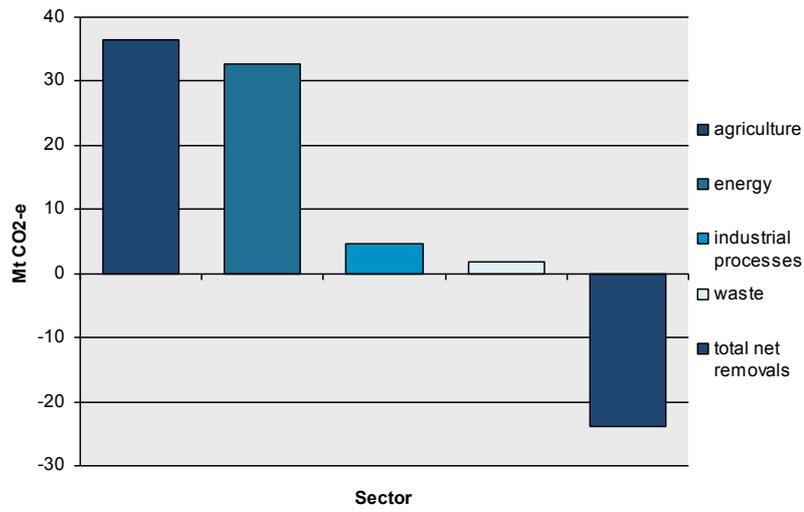
**Table 3 Summary of Atmosphere Data Evaluation**

	Strengths	Weaknesses
<b>Comprehensive time series</b>	<ul style="list-style-type: none"> <li>Greenhouse gas emissions and removals comprehensively reported for the period 1990 to the current year</li> </ul>	<ul style="list-style-type: none"> <li>No historical records available prior to 2005 for air quality data and prior to 1990 for greenhouse gases</li> <li>Stratospheric ozone data not available publicly. Graphs can only be reproduced from the MfE website, and the source data is from NIWA</li> <li>Air quality data recorded since 2005 for most regional councils, but not all airsheds monitored</li> </ul>
<b>Quality Data</b>	<ul style="list-style-type: none"> <li>National Environmental Standard for air quality comparable to World Health Organisation standard</li> <li>Greenhouse gas emissions and removals methodologies provided by the IPCC and UNFCCC</li> <li>Values for greenhouse gases recalculated when methodologies are revised</li> </ul>	<ul style="list-style-type: none"> <li>Limited comparability of collection methods of air quality data between each territorial authority</li> <li>Air quality data selected for one airshed per territorial authority</li> <li>Reliance on particulate matter as sole indicator for air quality</li> </ul>
<b>Appropriate Sources</b>	<ul style="list-style-type: none"> <li>Air quality regional authorities data meeting National Environmental Standard (NES)</li> <li>International review of greenhouse gases inventories</li> <li>Adaptable methodology to ensure air quality compliance</li> </ul>	
<b>Publicly available</b>	<ul style="list-style-type: none"> <li>MfE as a central point of air quality source data with most data publicly accessible and available for free</li> <li>Greenhouse gas emissions and removals also published by MfE and supported by the UNFCCC website</li> </ul>	<ul style="list-style-type: none"> <li>Particulate matter data for 2005 and 2006 not available on MfE website and needed to be requested</li> <li>Stratospheric ozone raw data not available.</li> <li>Only graphs referencing source data from NIWA data were available.</li> </ul>

The Institute acknowledges that other sources may need to be consulted in order to gain a complete and comprehensive overview of New Zealand's atmosphere. The Institute's dataset does not answer all the questions outlined in Section 1.3 but can provide background statistics to support reporting, analysis and argumentation, especially in regards to air quality and greenhouse gases emissions. An example of how the data may be used is presented in Figure 5 below.

**Figure 5 Net Greenhouse Gas Emissions by Sector, 2007**

Source: MfE, 2009a: iv



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