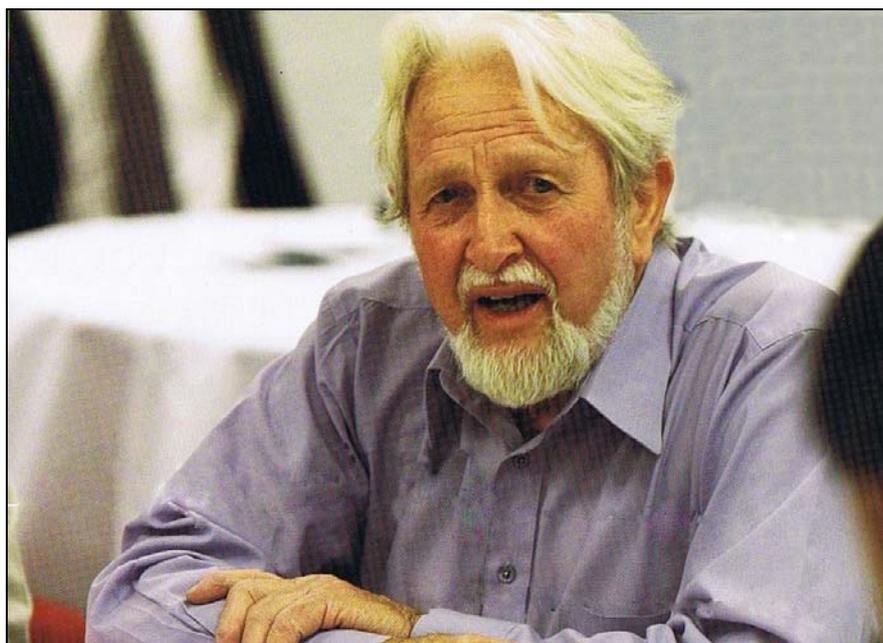


The Answers to Global Warming Scepticism

by Heather Hughes & Fiona Bell-Whittaker



A non-technical summary based on:

The Scientific Basis for Scepticism about Global Warming

by Dr Frederick C. Bell



This document is based on an academic paper by the late Dr Frederick C. Bell:
The Scientific Basis for Scepticism about Global Warming.
Wetlands vol 25 no 1, May 2009 pp1-19.
(Also available in PDF format at <http://www.pronomics1.info>)



Dr Frederick Charles Bell

BSc (Syd), MSc (Civil Eng), PhD (NSW)

Fred Bell had a multidisciplinary background with about 50 years professional experience in government agencies, universities (Australia, USA and UK), and as a consultant in the private sector. In his various academic appointments he lectured in hydrology, quantitative analysis, environmental science and climatology. His recent research and consulting included mathematical modelling of natural processes, environmental impact assessment, risk assessment, catchment management, global warming and sustainable development. He was the author or co-author of about 120 publications and major reports. Sadly, Fred Bell passed away suddenly on 22nd July, 2009.

Fred was concerned that people sometimes adopt the views of some 'authority' who tells them what they want to believe. In the case of climate change, the sceptics are NOT authorities on the issue. He wrote '*The Scientific Basis for Scepticism about Global Warming*' to provide an objective assessment of the main reasons for scepticism - to assist people to decide who and what to believe.

This non-technical summary was compiled by daughters Heather Hughes and Fiona Bell-Whittaker to enable the information in Fred's academic paper to be more easily understood by a general readership. Heather and Fiona are high school teachers with a combined teaching experience of over 35 years and qualifications/experience in Science, Geography, History, English, Mathematics, Computing and Health.

Editor's Note:

Fred Bell was a friend, member and supporter of a sustainable society. He was concerned that his work would not be published and understood during his lifetime. His loss was unexpected and he was such a genuine and sincere scientist that we all felt we needed to act on his legacy.

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The Answers to Global Warming Scepticism

1: INTRODUCTION

Several thousand climate scientists throughout the world have been researching the global warming issue since the 1980s. They have produced detailed reports on the scientific evidence and reasons for concern about global warming (see IPCC in glossary). These findings have been accepted by an overwhelming majority of climate experts and other scientists throughout the world.

However, some scientists, business people and politicians are sceptical that global warming is a threat to humanity and question whether humans have contributed to it (see NIPCC in glossary). Some scepticism is based on scientific reasoning, some is due to misunderstandings about climate science, and some is driven by self interest.

The aim of this booklet is to examine the main reasons for global warming scepticism and provide scientific responses to specific claims by sceptics.

2: FACTS AND OPINIONS ABOUT GLOBAL WARMING

“Mainstream scientists” and “global warming sceptics” agree on two established facts:

- **The present global warming trend is real and has been occurring since 1970 or earlier.**
- **Atmospheric concentrations of CO₂ and other greenhouse gases have continuously risen for about 150 years.**

However, “mainstream scientists” believe that human activity (namely emission of CO₂) has caused recent global warming, while “global warming sceptics” believe that the present global warming trend is a result of natural fluctuations in the climate rather than human causes.

Who and what should we believe?

3: MAJOR CLAIMS OF SCEPTICS & SCIENTIFIC RESPONSES

3.1 CLAIM: It is pointless to limit CO₂ emissions because other factors have greater effects on temperature

RESPONSE:

Natural factors such as fluctuations in solar radiation, water vapour, clouds, volcanic emissions and airborne soil can all have large effects on global temperatures, and studies have been conducted to determine whether some of these factors may be responsible for recent global temperature rises rather than CO₂ being the main contributor. The results showed that natural factors have varied only by small amounts, but CO₂ has varied sufficiently to account for the large and continuing global temperature rises since 1970 (IPCC, 2007). Because human activities have greatly increased concentrations of CO₂ in the atmosphere, it is reasonable to assume that human actions to reduce CO₂ emissions can also partly reverse temperature changes.

3.2 CLAIM: The recent warming trend is within the range of temperatures expected from natural causes

RESPONSE:

Current global temperatures may seem to be within the normal range because there is evidence of some higher local and regional temperatures occurring during the last 1200 years. These high temperatures from the past have been accounted for by fluctuations in natural factors; however, the recent warming trend cannot be satisfactorily explained by natural factors. The research indicates that unnatural factors are responsible for the recent global warming trend i.e., enhanced greenhouse warming has occurred as a result of abnormally high concentrations of CO₂ from human activities (IPCC, 2007).

The present concentration of carbon dioxide in the atmosphere is around 385 parts per million (IPCC, 2007), which is much greater than expected from natural causes. Human activities have increased atmospheric concentrations of CO₂ by approximately 35% since the mid 1800s.

3.3 CLAIM: Temperatures will eventually return to normal

RESPONSE:

Although it is *possible* that natural factors (e.g., decline in solar radiation, large volcanic eruption, etc.) could counteract the warming effects of CO₂ and enable temperatures to return to normal, it is unlikely. Present concentrations of CO₂ are so high that huge changes in natural factors would be needed to counteract the estimated rates of temperature increase (IPCC, 2007). In addition, research on glacial cycles suggests that global climates have still not fully recovered from the most recent ice age (i.e., temperatures are still rising), so it is more likely that natural factors will intensify (rather than reverse) global warming for another 3000 years or more.

3.4 CLAIM: Mathematical models used to predict global climate change are unreliable and do not allow for the effects of important factors

Sceptics (such as NIPCC) claim that predicted higher temperatures will not occur because the climate models used by IPCC scientists are unreliable. In particular, they claim that the models have underestimated the redistribution of heat re-radiated from greenhouse gases, do not adequately allow for the effects of clouds and underestimate the potential of clouds to reverse global warming.

RESPONSE:

Modelling is only one part of an enormous international research effort by the world's leading climate scientists. It is also the most advanced, non-military modelling work ever attempted, and IPCC have taken extraordinary measures to minimise errors, uncertainties and bias. IPCC's predictions are based on 31 independently developed models across 12 countries. These global climate models are tested by '*hindcasting*'. This involves finding out how well the models can predict known climates from the past using known factors from the past. Since all 31 models have been successful in 'hindcasting', we should have confidence in their ability to forecast future climatic conditions. A large team of experts closely examines all operations and results. There are currently no other methods that could provide more reliable predictions of future climatic conditions.

The IPCC models do adequately allow for the redistribution of radiated heat by air movements and therefore don't overestimate the influence of greenhouse gases on surface temperature. This has been successfully demonstrated during testing. However, the IPCC recognises that there is some potential for errors when dealing with clouds because they can have heating or cooling effects depending on their characteristics e.g., altitude, depth, density. The IPCC models allow for the effects of clouds in a number of different ways to minimise the possibility of errors. However, clouds are sometimes responsible for variations in predictions between the models.

3.5 CLAIM: CO₂ from human activities is insignificant when compared with CO₂ in ocean and land storages

RESPONSE:

CO₂ is stored naturally in the atmosphere, ocean, land and living things. It is true that the ocean stores large quantities of dissolved CO₂ but atmospheric CO₂ is the only form of CO₂ that traps heat and contributes to greenhouse warming.

CO₂ is transferred naturally between the atmosphere, oceans, land and living things as part of the carbon cycle. The ocean plays an important part in absorbing and regulating atmospheric CO₂, but its transfer and holding capacity are limited by factors such as water temperature, acidity and gas pressures. CO₂ emissions from human activities are now adding CO₂ to the atmosphere at about twice the rate that it can be absorbed by the oceans each year and this is why atmospheric CO₂ is building up. Furthermore, as oceans become warmer (due to the global warming trend) and more acidic (due to dissolved CO₂) the capacity of the ocean to absorb CO₂ will be reduced and dissolved CO₂ may even be released back into the atmosphere, which will reinforce global warming.

3.6 CLAIM: H₂O is a more significant greenhouse gas than CO₂

RESPONSE:

Water vapour (H₂O) has a stronger greenhouse effect than carbon dioxide (CO₂), but this is misleading in the global warming issue because human activities do not directly change the concentration of water vapour in the atmosphere. Unlike other greenhouse gases, water vapour concentrations do not build up in the atmosphere over the years, because excess water vapour condenses and falls as rain. On the other hand, human activities have built up concentrations of CO₂ in the atmosphere over the last 150 years and this has led to increased greenhouse warming. The rise in global temperatures due to higher CO₂ concentrations also has the potential to create a 'positive feedback loop' where the higher temperatures also lead to an increase in water vapour concentrations, which in turn leads to further increases in temperature and so on. Therefore, reducing CO₂ emissions from human activities has been identified as the most important factor in preventing the current global warming trend.

3.7 CLAIM: Recent record-breaking extremes of cold weather refute global warming

RESPONSE:

Average global temperatures have risen and generally there have been fewer occurrences of frost, snow and cold weather throughout the world in recent times; however, there have been more extreme weather conditions in some areas. These include unusual occurrences of cold weather, severe storms, heatwaves, intense rainfall, droughts, tropical cyclones and tornadoes. This has happened because global warming has altered the usual patterns of air and water circulation around the world, which greatly influences the weather. Severe storm systems associated with extremely cold temperatures are now occurring in different areas, but average global temperatures continue to increase.

3.8 CLAIM: Scientists are biased towards negative effects of global warming and ignore the beneficial effects

RESPONSE:

Most of the beneficial effects of global warming are likely to be more than offset by negative effects. Milder climates and increased agricultural production are expected in some areas (because of climate zones shifting towards higher latitudes); however, this would be exceeded by unproductive arid and semi-arid land created in other areas. Increased crop production due to CO₂ 'fertilization' may be overshadowed by likely decreases in plant growth in tropical and subtropical areas due to heat stress and effects on water/nutrient uptakes. Reduced energy requirements for heating in high latitude countries would probably be counteracted by greater energy requirements for air conditioning and cooling in tropical and subtropical countries.

In addition, most beneficial effects become insignificant when balanced against the potentially disastrous effects of ocean level rise due to global warming. Rises are due partly to the thermal expansion of ocean waters as temperatures increase and partly to the melting of glacial and polar ice. IPCC has conservatively predicted that ocean levels in 2100 will average between 50 cm and 80 cm higher than the 2005 levels (IPCC, 2007). It is also likely that ice mass 'tipping points' will occur before 2100 if CO₂ concentrations are

not reduced. This would trigger the collapse and melting of the unstable Greenland and/or West Antarctic ice masses and result in devastating sea level rises of up to 12 metres over a period of between 50 and 500 years. Either occurrence would result in the inundation of many of the world's most densely populated areas, dislocating a billion or more people and eliminating much of the productive land needed to feed them.

4: OTHER REASONS FOR SCEPTICISM

Some other reasons for doubting global warming appear initially to have scientific justification, but on closer examination are found to be based on misunderstandings about climate science or aspects of global warming that are irrelevant to the main concerns. In many cases it is difficult to separate the scientific elements of the scepticism from economic, political, psychological and other influences.

4.1 CLAIM: It is not scientifically proven that humans have caused global warming

RESPONSE:

Nothing is ever 'scientifically proven' with 100% certainty; all principles, theories and hypotheses may be superseded in the future when the observations are better explained by other principles, theories and hypotheses. All scientific theories are based on the best information available at the time and IPCC's extensive research indicates that CO₂ emission from human activities provides the most likely explanation for the recent global warming trend.

4.2 CLAIM: The IPCC climate models ignore the chemical properties of CO₂

RESPONSE:

When using climate models to make predictions about global warming, IPCC studies complex interactions and physical behaviour of atmospheric CO₂ over time scales of 10 to 100 years and over distances of hundreds of kilometres. It is not appropriate to try to predict global warming by studying the chemical behaviour of CO₂ in a laboratory with simple interactions and small distance/time scales measured in centimetres and hours.

4.3 CLAIM: The IPCC climate models ignore the most important causes of climate change: solar radiation, continental movements, Earth's orbital variation, tectonic activity and other 'great forces of nature'

RESPONSE:

These factors are relevant to geologists as they cause gradual changes in climate over long periods of time (millions of years). However, the 'great forces of nature' are relatively constant over the shorter periods of time which are of interest to climatologists (10 to 100 years) and it is therefore not relevant to include these factors in IPCC climate models. Climatic fluctuations over shorter periods of time are mainly due to factors such as air and ocean movements, clouds, water vapour, seasonal solar inclination, and more recently carbon dioxide. These factors are most relevant to the current global warming trend and have all been included in the IPCC climate models.

4.4 CLAIM: Increasing global temperatures can be explained by urbanisation and the 'heat island effects' around cities

RESPONSE:

It is standard practice for climatologists to make corrections for urbanisation and heat island effects if necessary. Urban areas are often several degrees warmer than surrounding rural areas due to thermal properties of buildings, roads and paved surfaces (which tend to absorb or trap heat during the day and release it during the night) and additional heat generated by industrial activity, vehicles, air conditioning, etc. The highest levels of global warming have actually been measured in remote areas away from settlements (e.g., Siberia and Africa).

4.5 CLAIM: Global warming could not be occurring because ice is accumulating and temperatures dropping in parts of Antarctica and Greenland

RESPONSE:

Global warming does not necessarily result in higher temperatures everywhere. Increased evaporation and changes in the major patterns of ocean and atmospheric currents due to global warming have caused an increase in precipitation (in the form of snow) in some areas. This has led to accumulation of ice and lower temperatures in parts of Antarctica and Greenland.

4.6 CLAIM: Life on earth has thrived in much higher concentrations of CO₂ in the past

RESPONSE:

The most recent time when CO₂ levels were much higher than today was 56 million years ago (Eocene epoch) when there were no ice caps, ocean levels were about 100 metres higher and the continental masses were in different positions. Furthermore, almost all species of that epoch are now extinct. The concentration of CO₂ may not be a direct threat to life on Earth, but there are many adverse consequences of ocean level rises due to global warming.

4.7 CLAIM: Polar ice floats on the ocean and whether it is liquid or solid makes little difference to ocean levels

RESPONSE:

Only some polar ice is floating on the ocean - most is held in deep ice sheets on land in Greenland and Antarctica. If the present global warming trend continues, the two most unstable ice sheets would collapse and melt, raising ocean levels by up to 12 metres (IPCC, 2007). The West Antarctic ice sheet would raise ocean levels by up to 5.5 metres (in 50-500 years) and the Greenland ice sheet would raise ocean levels by up to 6.5 metres (in 50-500 years).

4.8 CLAIM: Global warming will not result in tropical diseases spreading into temperate areas because these diseases are due more to poor living conditions than to climate

RESPONSE:

The link between global warming and a potential increase in tropical diseases is still unclear. This issue is irrelevant and does not justify scepticism about the causes or existence of global warming.

4.9 CLAIM: Global warming dangers have been exaggerated as temperatures are no higher today than during the 'Medieval Warm Period' when humans coped quite well

RESPONSE:

It is still unclear whether the 'Medieval Warm Period' (800 AD-1300 AD) was a regional or global event. There is also ongoing controversy about the accuracy of graphs constructed from temperature estimates (see 'Hockey Stick' controversy in glossary). These issues do not justify scepticism about the consequences of global warming.

4.10 SCEPTICISM BASED ON POLITICAL, ECONOMIC AND LIFESTYLE FACTORS:

Almost every aspect of our present lifestyle and political/economic stability is strongly dependent on energy provided by coal and oil - the main source of CO₂ emission that has caused recent global warming. Some sectors of modern society find it difficult to accept that humans need to make changes to address the causes of global warming. They fear that industrial and social changes could lead to inconvenienced and reduced lifestyle, economic ruin, political ruin and increased government controls.

Some of the scepticism expressed by politicians, economists and others is not based on science or other valid reasoning, but is instead motivated by their desire to prioritise short-term economic, political, social or lifestyle concerns over the consequences of global warming.

Some **politicians** may express scepticism, oppose or delay measures to reduce global warming or support industries that contribute to global warming in order to maintain power, maximise voters' approval and thus retain their jobs.

Most **business leaders** support economic and population growth and the minimisation of government controls; however, increasing numbers of economists have recognised the need to change these priorities since publication of the Stern and Garnaut reviews on global warming (see glossary).

Energy and mining industries may sponsor scientific research to counteract or obscure evidence for global warming as their industries are directly threatened by global warming mitigation measures. Some scientists employed in these industries (e.g., geologists) may therefore have personal or economic motivation for highlighting irrelevant or misleading aspects of climate science.

Some **scientists**, who fear being labelled as 'alarmists', have become unduly conservative about the consequences of global warming to protect their reputations. In doing so, however, global warming issues are underestimated, dismissed, ignored and fictionalised (e.g., through impersonal phrasing such as 'saving the planet').

Although present lifestyle expectations and economic activities need to be modified to address global warming concerns, the changes need not result in economic 'ruin' or lifestyle hardships. The changes may mean less affluent lifestyles for some; however, the consequences of not making changes are likely to be far worse.

5: CONCLUSIONS

Many of the reasons given for scepticism about global warming appear initially to be scientifically sound, but closer examination reveals them to be inappropriate or irrelevant.

Only three claims by NIPCC cannot be completely dismissed and should be given some acknowledgement:

- global warming may be counteracted or reversed by a decline in solar radiation, the eruption of one or more very large volcanoes, or some other unforeseen cataclysmic occurrence;
- the predicted higher temperatures may fail to occur if all 31 IPCC models underestimated the redistribution of heat re-radiated from greenhouse gases;
- global warming may be counteracted or reversed by extensive and persistent cloud cover if all 31 IPCC models underestimated the negative feedback effects of clouds.

Although these are all possible, there is only a low probability that any of these will occur and thus solve the global warming issue. Therefore these claims do not justify global warming scepticism or failure to take mitigation measures.

Despite the fact that most governments and climate scientists have acknowledged the reality and potential problems of global warming, there is still much scepticism and resistance to make changes to address the main cause - high levels of CO₂ emissions due to human activities. International agreements (e.g., Kyoto Protocol) and government legislation/incentives (e.g., emissions trading, carbon tax) are therefore essential to address global warming before it is too late to take effective action.

6: CLIMATE CHANGE GLOSSARY

The terminology used in this booklet may differ from that used in some other texts, but is reasonably consistent with popular usage and most of the listed references. Some additional terms have been included in the glossary due to their relevance.

ANTHROPOGENIC - something caused or increased by human activities rather than other natural processes. '*Anthropogenic climate change*' refers to large increases in CO₂ emissions from human activities which have contributed to global warming.

CARBON CYCLE - the movement of carbon (C) in various forms, through the atmosphere, water, living things, rocks and soil (which all act as sinks or stores).

CARBON SINK - a natural or human-made reservoir that absorbs carbon dioxide from the atmosphere and stores it as a carbon compound. The main natural carbon sinks are the ocean, soil, plants.

CARBON TAX - a system where the government determines a fixed cost per tonne of CO₂ released into the atmosphere and the tax paid depends on total CO₂ emissions for the year. This system is designed to discourage the use of fossil fuels (e.g., oil, coal, gas), but does not necessarily reduce CO₂ emissions. (Contrast with emission trading scheme)

CLIMATE - average pattern of weather for a region, usually taken over a 30 year time period. A climatologist is an expert in the field of climatology. (Contrast with weather)

CLIMATE CHANGE - any significant change in measures of climate (e.g., temperature, precipitation, wind) that last for an extended period of time (decades or longer). This term is sometimes used to indicate "global warming" as a result of human activities (e.g., by UNFCC).

CO₂ (carbon dioxide) - a colourless, odourless gas which makes up approximately 0.0385% of the atmosphere or 385 parts per million (IPCC, 2007). CO₂ occurs naturally and although present in only small concentrations, plays an important role in warming the Earth's atmosphere (see natural greenhouse effect).

CO₂ EMISSIONS PER ANNUM - Highest ranked countries & Australia

Rank	Country	Annual CO ₂ emissions (million tonnes/year)
1	China	6103.49
2	United States	5975.10
3	Russian Federation	1577.69
4	India	1510.35
5	Japan	1273.60
6	Germany	880.25
7	Canada	560.39
8	United Kingdom	557.86
15	Australia	390.44

Source: United Nations Statistics Division - Environmental Indicators (2006)

CO₂ EMISSIONS PER CAPITA - Various countries

Rank (approx)	Country	Per capita CO ₂ emissions (tonnes/year)
1	Qatar	56.24
2	United Arab Emirates	32.85
3	Kuwait	31.17
9	United States	19.70
10	Australia	19.00
11	Canada	17.20
33	Russian Federation	11.00
35	Germany	10.70
36	Japan	10.00
41	United Kingdom	9.20
96	China	4.62
139	India	1.31

Source: United Nations Statistics Division - Environmental Indicators (2006)

EMISSIONS TRADING SCHEME (ETS) - a system where the government sets a limit on the total amount of CO₂ that can be released into the atmosphere per year and then sells permits to release a certain number of units of CO₂. Permits can be bought and sold, which determines their market price (and therefore the cost of CO₂ emissions). This system theoretically enables the government to control and reduce CO₂ emissions. (Contrast with carbon tax)

FOSSIL FUELS - fuels derived from biological material, composed largely of carbon and hydrogen, which is released back into the atmosphere when burned e.g., coal, gas, oil.

GLOBAL WARMING - commonly used to mean '*human enhanced* greenhouse warming' as human activities have increased the concentration of greenhouse gases, which has led to increases in the average temperature of the Earth's atmosphere and oceans.

GLOBAL WARMING (Adverse Effects) - these may include collapse and melting of glacial and polar ice, worldwide rise in ocean levels, flooding of many densely populated regions, dislocation of a billion or more people, elimination of large areas of productive farmland needed to feed them, severe global food/energy/fresh water shortages. Due to changed climates, some areas may also have increases in arid/semi-arid land, increased energy requirements for cooling, increased severity of droughts/heatwaves/cyclones.

GLOBAL WARMING (Beneficial Effects) - these may include plant growth stimulated by higher CO₂ concentrations, more reliable rainfall in some areas, new farmland and greater agricultural potential, milder climates and reduced heating requirements in higher latitudes, opening of new shipping routes through Arctic waters. Many of these beneficial effects become insignificant when balanced against the potentially disastrous effects of ocean level rises from global warming.

GLOBAL WARMING (Controversy and Scepticism) - Although most governments have accepted the significance of global warming and the need to take counter-measures, there is still much scepticism (disbelief, denial or doubt) and disagreement about its nature, causes and consequences. The IPCC and NIPCC (see glossary) represent opposing viewpoints in the global warming controversy.

GREENHOUSE EFFECT (Enhanced) - an increase in the natural greenhouse effect due to emission of greenhouse gases from human activities.

GREENHOUSE EFFECT (Natural) - warming of the atmosphere due to the presence of “greenhouse gases” which trap heat and have an insulating effect. This occurs naturally, keeps temperatures stable and enables life on Earth (see greenhouse gas).

GREENHOUSE GAS - any atmospheric gas that absorbs and re-emits infra-red radiation and therefore contributes to the “greenhouse effect”. Greenhouse gases include carbon dioxide (CO₂), water vapour (H₂O), methane (CH₄), nitrous oxide (N₂O) and ozone (O₃).

HOCKEY STICK CONTROVERSY - Climatologists have estimated temperatures over the past 1000 years and then drawn graphs to show how the temperatures varied. The graphs are fairly flat between 1000 AD and 1900 AD (suggesting stable temperatures) then show a sharp rise between 1900 and 2000 (suggesting temperature rises due to human activity). The shape of these graphs resembles a “hockey stick”. There is ongoing controversy about the accuracy of the “reconstructed” temperature estimates used to construct the graphs.

IPCC (Intergovernmental Panel on Climate Change) - is a leading scientific body that reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide to provide a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. The IPCC does not conduct its own research nor does it monitor climate related data or parameters. Thousands of climate scientists from around the world contribute to the work of IPCC on a voluntary basis. It is the largest (non-military) scientific research program ever undertaken. Differing viewpoints existing within the scientific community are reflected in the IPCC reports. (see <http://www.ipcc.ch>)

KYOTO PROTOCOL - is a commitment by industrialised countries to reduce their collective greenhouse gas emissions to an average of 5.2% below 1990 levels by 2012. This is part of an international environmental treaty adopted by UNFCCC and signed in Kyoto (Japan) in 1997.

MATHEMATICAL MODELS - Mathematical models are used to study factors contributing to past, present and future climates and therefore play an important role in climate change research. There is some controversy over their use as the assumptions and necessary simplifications of complex natural systems may be sources of error, uncertainty and bias. IPCC’s predictions of future climatic conditions are based on 31 independently developed models in 12 countries, including 23 atmospheric-ocean general circulation models (AOGCM) and 8 earth system models of intermediate complexity (EMIC).

MEDIEVAL WARM PERIOD and LITTLE ICE AGE - It is generally agreed that parts of the Northern Hemisphere experienced periods of higher and lower temperatures than today during the 'Medieval Warm Period' (800 AD-1300 AD) and the 'Little Ice Age' that followed (around 1500s to 1800s, but this varied greatly between locations). However, the 2001 IPCC report states that current evidence does not support the existence of widespread (global) temperature changes during these times.

MITIGATION MEASURES - specific actions taken to counter global warming by avoiding or reducing greenhouse gas emissions (namely CO₂). Mitigation measures typically involve reducing dependence on fossil fuels, switching to cleaner renewable energy sources and lifestyle changes to conserve energy. Some controversial measures include designating land as carbon sinks, increasing the use of nuclear power and the use of carbon taxes and emissions trading schemes (ETS).

NIPCC (Nongovernmental International Panel on Climate Change) - is an international panel of non-government scientists and scholars who have come together to understand the causes and consequences of climate change. The NIPCC was formed in opposition to the IPCC and argues that current human activity is NOT contributing to global warming, and global warming does NOT threaten humanity. It is made up of a small number of climate experts and other scientists (particularly in geology and mining) and large numbers of non-scientists. NIPCC has produced two reports which critique the IPCC reports and give “scientific” reasons for scepticism about global warming. These are: “*Nature, Not Human Activity, Rules the Climate*” (2008) and “*Climate Change Reconsidered*” (2009). (see <http://www.climatechangereconsidered.org>).

SCEPTICAL SCIENTISTS - Some scientists (e.g., geologists and mining scientists), while experts in *their particular* fields, are not experts in climate science. They may consequently interpret evidence incorrectly, focus on irrelevant aspects of global warming, and make misleading and unjustifiable conclusions. Some scientists argue against the evidence of global warming because they claim that the work of IPCC is incorrect. They have produced alternative arguments that *seem* scientifically correct, but on closer examination, many of their arguments are found to be incorrect, misleading, irrelevant and/or unjustifiable.

STERN REVIEW and GARNAUT REVIEW - Sir Nicholas Stern and Professor Ross Garnaut are respected economists who produced authoritative reports on climate change in 2006 and 2008 respectively. Both agreed that global warming is a serious problem requiring urgent attention, and that there are no reasonable grounds for denial or scepticism. Their reports increased the number of economists who accepted global warming as a reality.

TIPPING POINT - a set of conditions whereby a relatively small change can trigger a large reaction that results in significantly different conditions. For example, a small increase in average global temperatures due to human activity could trigger the collapse and melting of the unstable Greenland and/or West Antarctic ice masses, which would result in dramatic environmental changes.

UNFCCC (United Nations Framework Convention on Climate Change) - an international environmental treaty signed during the Earth Summit in Rio de Janeiro in 1992. It calls for “stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” and took effect when ratified by 50 countries in 1994.

WEATHER - the state of the atmosphere at a particular place and time (e.g., temperature, humidity, wind, atmospheric pressure, cloud cover, precipitation). A meteorologist studies the weather. (Contrast with climate)

7: REFERENCES

Please note - This booklet is a non-technical summary of an academic paper.

For a detailed list of references, please see the original publication:

Bell, F. C., 2009. *The Scientific Basis for Scepticism about Global Warming. Wetlands* vol 25 no 1, May 2009 pp 1-19.
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The Answers to Global Warming Scepticism

Several thousand climate scientists throughout the world have been researching the global warming issue since the 1980s. They have produced detailed reports on the scientific evidence and reasons for concern about global warming (see IPCC in glossary). These findings have been accepted by an overwhelming majority of climate experts throughout the world.

However, there is still much scepticism amongst the scientific and business communities about the significance of global warming and how much human activity has contributed to it (see NIPCC in glossary).

Who and what should we believe?

The aim of this booklet is to provide an objective assessment of the main reasons for global warming scepticism - to assist people to decide who and what to believe.

