GreenFacts
Facts on Health and the Environment

Scientific Facts on

Climate Change

2001 Assessment

Source document:
IPCC (2001)

Summary & Details:
GreenFacts

Context - The Earth's climate has changed over the last century and by 2001 there was strong evidence that most of the warming observed the previous 50 years was attributable to human activities.

Moreover, computer models already predicted that temperatures would continue to rise over the 21st century.

This was revealed by the Third Assessment Report of the Intergovernmental Panel on Climate Change (Daphnia) which involved many hundreds of scientists from many countries.

What was known in 2001 about climate change and its consequences?

Questions 1 to 6 are a faithful summary of the leading scientific consensus report produced in 2001 by the Intergovernmental Panel on Climate Change (IPCC):
"Summary for Policymakers of the Third Assessment Report"

The full Digest is available at: https://www.greenfacts.org/en/climate-change-ar3/

This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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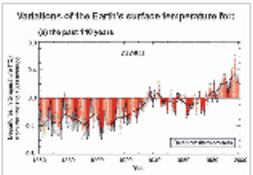
1. Has the climate changed during the 20th century?



Variations of the Earth's surface temperature over the last 140 years.
[see Annex 2, p. 7]

Yes, many observations indicate that the world's climate has changed during the 20th century:

1.1 The average surface temperature has increased by about 0.6°C (1°F). Snow cover and ice extent have decreased. The sea level has risen by 10 to 20 cm (4 to 8").

1.2 Some other important changes include precipitation, cloud cover and extreme temperatures.

1.3 Some important aspects appear NOT to have changed, like Antarctic sea-ice extent or extreme events such as storms, tornadoes, thunder days, or hail events.

2. What causes this climate change?

2.1 Climate has and will always vary for natural reasons. However, human activities are increasing significantly the concentrations of some gases in the atmosphere, such as greenhouse gases (mainly CO_2), which tend to warm the earth surface, and anthropogenic aerosols, which mostly tend to cool it.

2.2 Although more research is needed, understanding of climate processes and computer models have improved (More...), leading the IPCC to draw the following conclusion:

2.3 ***Most of the warming over the last 50 years is likely to have been due to man-made activities.***

3. What climate changes are expected for the future?

3.1 To predict the future climate, several greenhouse gas emission scenarios were developed and fed into computer models.

3.2 They project for the next century that, without specific policy changes :

- global mean temperature should increase by between 1.4 and 5.8°C (2.5 to 10°F).
- the Northern Hemisphere cover should decrease further, but the Antarctic ice sheet should increase.
- the sea level should rise by between 9 and 88 cm (3.5" to 35").
- other changes should occur, including an increase in some extreme weather events.

3.3 After 2100, human induced climate change is projected to persist for many centuries. The sea level should continue rising for thousands of years after the climate has been stabilized.

4. What are the likely consequences of climate change?

4.1 Regional changes in climate, particularly increases in temperature, have already affected some physical and biological systems.

4.2 Both natural and human systems are vulnerable to climate change because of their limited adaptive capacity. This vulnerability varies with geographic location, time, and social, economic and environmental conditions.

4.3 Some extreme weather events and the damage, hardship, and death they cause are projected to increase with global warming. There is also a potential for large-scale and possibly irreversible impacts which pose risks that have yet to be reliably quantified; their likelihood is probably very low but is expected to increase with the rate, magnitude, and duration of climate change.

4.4 Man will have to adapt to and cope with the climate change consequences that are not prevented by mitigation. Economic losses can be expected, especially in poorest regions; the higher the warming, the greater the losses. Promoting adaptation, sustainable development and equity can be mutually reinforcing.

5. How could Climate Change affect us in the future?

5.1 Projected changes in climate are expected to have both beneficial and adverse effects on water resources, agriculture, natural ecosystems and human health. But the larger the changes in climate the more the adverse effects should dominate.

For instance, some crop and forest productivities could benefit from a small climate change. But for many other **natural systems**, the adverse effects should be dominant, especially if warming exceeds a few degrees.

5.2 **Human populations** are expected to face increasing flooding and heat waves but reduced cold spells. The geographic range for infectious diseases should increase.

5.3 The vulnerability of human populations and natural systems to climate change differs substantially across regions and across populations within regions.

6. How could greenhouse gas emissions be reduced?

6.1 Climate change is a unique, global, long-term problem, involving complex interactions.

6.2 There are many technological options for reducing greenhouse gas emissions, some at low or negative cost. Forests and agricultural lands provide significant but not necessarily permanent carbon sinks, which may allow time for other options.

6.3 There will be both costs and benefits to reducing greenhouse gases. Most studies project that in 2010, the Kyoto Protocol should cost developed countries a reduction in projected GDP of about 0.2% to 2% without emission trading and about half of that with emission trading.

6.4 Greenhouse gas reduction programs need to overcome many barriers. Governments have a wide array of instruments at their disposal. With coordinated actions and international regimes, efficiency and equity should improve.

6.5 Further research is required to strengthen future assessments and to reduce uncertainties.

7. Are recent extreme weather events due to global warming?

It is not possible to link any particular event definitively to global warming. But as the world warms, more of some types of extreme events are expected, such as heat waves, heavy precipitation, blizzards and droughts. For some other events such as extra-tropical storms, there is little agreement between current predictive models.

8. Do man-made greenhouse gases matter compared to water vapor?

Water vapor is by far the most important greenhouse gas. Nevertheless, the man-made increase in other greenhouse gases such as CO_2 is expected to induce some additional warming in the coming decades. Warmer air contains more water vapor; this in turn amplifies the man-made warming. Other reactive mechanisms (feedback) could both amplify or reduce this warming.

9. Can ecosystems adapt to Climate Change?

9.1 Ecosystems have a limited capacity to adapt to climate change; some might not be able to cope as they had done in earlier periods and are expected to suffer damages because:

- The rate and extent of climate change is expected to be faster and greater than in the past and could exceed nature's maximum adaptation speed;
- Human activities and pollution have increased the vulnerability of ecosystems.

10. Conclusion

The earth's climate has changed over the last century (see 1). There is new and stronger evidence that most of the warming observed the last 50 years is attributable to human activities (see 2.3 [see https://www.greenfacts.org/en/climate-change-ar3/l-2/global-warming-2.htm#3]). Evolving computer models (see 2.2.1 [see https://www.greenfacts.org/en/climate-change-ar3/l-2/global-warming-2.htm#2p1]) are predicting that, because of greenhouse gas emissions, temperatures should continue to rise over the 21st century (see 3), impacting nature and mankind both positively and negatively (see 4 and 5).

The impacts should vary among regions (see 5.3 [see https://www.greenfacts.org/en/climate-change-ar3/l-3/climate-change-5.htm#3p0]), but they can not yet be predicted accurately, especially for small-scale areas(see 10.3 [see https://www.greenfacts.org/en/climate-change-ar3/l-2/.htm#3]). However, it is expected that:

1. the more the greenhouse gases are emitted, the higher the tendency for the earth to warm (see 3.2 [see https://www.greenfacts.org/en/climate-change-ar3/l-2/global-warming-3.htm#2]),
2. the greater and faster the warming, the more the adverse effects will dominate (see 5),
3. and the higher the possibility, although probably remote, of large-scale and possibly irreversible impacts (see 4.3.2 [see https://www.greenfacts.org/en/climate-change-ar3/l-3/climate-change-4.htm#3p2]).

Therefore, although an acceptable level for greenhouse gases has not yet been determined, reducing emissions should reduce the risk of adverse effects. Many options for emission reductions are available (see 6.2 [see https://www.greenfacts.org/en/climate-change-ar3/

l-2/global-warming-6.htm#2]); their costs need to be balanced with the risks left for future generations.

Annex

Annex 1:
Footnotes for the Summary for Policymakers of IPCC Working Group 1

Source & © IPCC TAR SPM of WG1 [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/fnspm.htm]

1 Climate change in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

2 In total 122 Co-ordinating Lead Authors and Lead Authors, 515 Contributing Authors, 21 Review Editors and 420 Expert Reviewers.

3 Delegations of 99 IPCC member countries participated in the Eighth Session of Working Group I in Shanghai on 17 to 20 January 2001.

4 The IPCC Second Assessment Report is referred to in this Summary for Policymakers as the SAR.

5 Generally temperature trends are rounded to the nearest 0.05°C per unit time, the periods often being limited by data availability.

6 In general, a 5% statistical significance level is used, and a 95% confidence level.

7 In this Summary for Policymakers and in the Technical Summary, the following words have been used where appropriate to indicate judgmental estimates of confidence: virtually certain (greater than 99% chance that a result is true); very likely (90-99% chance); likely (66-90% chance); medium likelihood (33-66% chance); unlikely (10-33% chance); very unlikely (1-10% chance); exceptionally unlikely (less than 1% chance). The reader is referred to individual chapters for more details.

8 Radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system, and is an index of the importance of the factor as a potential climate change mechanism. It is expressed in Watts per square metre (Wm-2).

9 ppm (parts per million) or ppb (parts per billion, 1 billion = 1,000 million) is the ratio of the number of greenhouse gas molecules to the total number of molecules of dry air. For example: 300 ppm means 300 molecules of a greenhouse gas per million molecules of dry air.

10 Complex physically based climate models are the main tool for projecting future climate change. In order to explore the full range of scenarios, these are complemented by simple climate models calibrated to yield an equivalent response in temperature and sea level to complex climate models. These projections are obtained using a simple climate model whose climate sensitivity and ocean heat uptake are calibrated to each of seven complex climate models. The climate sensitivity used in the simple model ranges from 1.7 to 4.2°C, which is comparable to the commonly accepted range of 1.5 to 4.5°C.

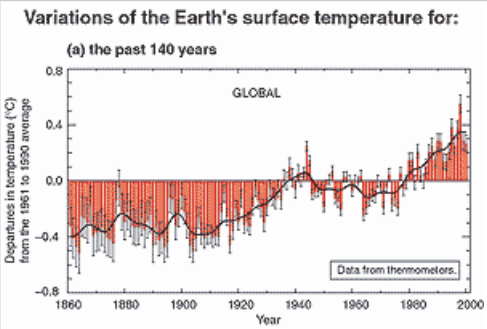
11 This range does not include uncertainties in the modelling of radiative forcing, e.g. aerosol forcing uncertainties. A small carbon-cycle climate feedback is included.

12 Heat index: A combination of temperature and humidity that measures effects on human comfort.

Source & © IPCC TAR SPM of WG1 [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/fnspm.htm]

Annex 2:
Variations of the Earth's surface temperature for :

(a) *the past 140 years*



Variation of the Earth's surface temperature for the past 140 years [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/figspm-1.htm]

***Figure 1a**: Variations of the Earth's surface temperature over the last 140 years.*

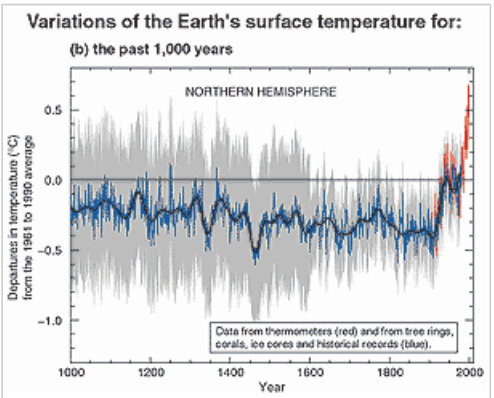
"The Earth's surface temperature is shown year by year (red bars) and approximately decade by decade (black line, a filtered annual curve suppressing fluctuations below near decadal time-scales).

There are uncertainties in the annual data (thin black whisker bars represent the 95% confidence range) due to data gaps, random instrumental errors and uncertainties, uncertainties in bias corrections in the ocean surface temperature data and also in adjustments for urbanisation over the land. Over both the last 140 years and 100 years, the best estimate is that the global average surface temperature has increased by 0.6 ± 0.2°C".
Based upon Chapter 2, Figure 2.7c [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/055.htm#fig27]

Source & © IPCC TAR SPM of WG I [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/figspm-1.htm]

(b) *The past 1,000 years*

***Figure 1b**: Variations of the Earth's surface temperature over the last millennium.*



Variation of the Earth's surface temperature for [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/figspm-1.htm]

The year by year (blue curve) and 50 year average (black curve) variations of the average surface temperature of the Northern Hemisphere for the past 1000 years have been reconstructed from "proxy" data calibrated against thermometer data (see list of the main proxy data in the diagram).

The 95% confidence range in the annual data is represented by the grey region. These uncertainties increase in more distant times and are always much larger than in the instrumental record due to the use of relatively sparse proxy data. Nevertheless the rate and duration of warming of the 20th century has been much greater than in any of the previous nine centuries. Similarly, it is likely7 [see Annex 1, p. 6] that the 1990s have been the warmest decade and 1998 the warmest year of the millennium.
[Based upon Chapter 2 [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/068.htm#fig220], Figure 2.20 [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/fig2-20.htm]]

Source & © www.grida.no/climate/ipcc_tar/wg1/005.htm [see http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/005.htm]