



Highlights from
Climate Change 2007: The Physical Science Basis
Summary for Policy Makers
Contribution of Working Group I to the Fourth Assessment Report of the
Intergovernmental Panel on Climate Change

On February 2, 2007, the Intergovernmental Panel on Climate Change released its Summary for Policymakers for the contribution of Working Group I to the Fourth Assessment Report (AR4) on climate change science. This document summarizes, in plain language, progress that has been made in understanding human and natural drivers of climate change, observed climate change, climate processes and attribution, and estimates of projected future climate change.

The AR4 provides the strongest statement to date on the extent and causes of climate change. This report expresses much greater confidence than past assessments that most of the observed warming over the past half-century is caused by human activities (greater than 90% certainty). It notes that the rates of warming and sea level rise accelerated during the 20th century, the latter representing a major new finding. It also notes other important changes such as more intense precipitation, drought, and to some extent tropical cyclones.

Because real-world observations have been greatly bolstered in this report, a particular strength of the AR4 over past reports is the overlap of nearly two decades between observational data and model projections. For certain aspects of climate change, such as the global temperature trends and rise in CO₂, the models reflect the observed changes reasonably well. In other cases, such as observed sea level rise, the models undershoot the actual observed change.

Another strength of the AR4 is enhanced detection of human influence on climate at the regional scale, such as increases in precipitation in the Eastern U.S. and decreased precipitation in the Southwestern U.S.

The following materials are drawn from the report either verbatim or in summary.

The following table is directly excerpted from p. 7 of the Summary for policymakers.

Table SPM-1. Recent trends, assessment of human influence on the trend, and projections for extreme weather events for which there is an observed late 20th century trend. {Tables 3.7, 3.8, 9.4, Sections 3.8, 5.5, 9.7, 11.2-11.9}

Phenomenon ^a and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend ^b	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	<i>Very likely</i> ^c	<i>Likely</i> ^e	<i>Virtually certain</i> ^e
Warmer and more frequent hot days and nights over most land areas	<i>Very likely</i> ^d	<i>Likely (nights)</i> ^e	<i>Virtually certain</i> ^e
Warm spells / heat waves. Frequency increases over most land areas	<i>Likely</i>	<i>More likely than not</i> ^f	<i>Very likely</i>
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	<i>Likely</i>	<i>More likely than not</i> ^f	<i>Very likely</i>
Area affected by droughts increases	<i>Likely</i> in many regions since 1970s	<i>More likely than not</i>	<i>Likely</i>
Intense tropical cyclone activity increases	<i>Likely</i> in some regions since 1970	<i>More likely than not</i> ^f	<i>Likely</i>
Increased incidence of extreme high sea level (excludes tsunamis) ^g	<i>Likely</i>	<i>More likely than not</i> ^{f, h}	<i>Likely</i> ⁱ

Notes:

(a) See Table 3.7 for further details regarding definitions

(b) See Table TS-4, Box TS-3.4 and Table 9.4.

(c) Decreased frequency of cold days and nights (coldest 10%)

(d) Increased frequency of hot days and nights (hottest 10%)

(e) Warming of the most extreme days and nights each year

(f) Magnitude of anthropogenic contributions not assessed. Attribution for these phenomena based on expert judgement rather than formal attribution studies.

(g) Extreme high sea level depends on mean sea level and on regional weather systems. It is defined here as the highest 1% of hourly values of observed sea level at a station for a given reference period.

(h) Changes in observed extreme high sea level closely follow the changes in mean sea level (5.5.2.6). It is *very likely* that anthropogenic activity contributed to a rise in mean sea level. (9.5.2)

(i) In all scenarios, the projected global mean sea level at 2100 is higher than in the reference period. (10.6). The effect of changes in regional weather systems on sea level extremes has not been assessed.

Following are summary statements covering the report's main findings.

I. HUMAN AND NATURAL DRIVERS OF CLIMATE CHANGE

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture.

The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report (TAR), leading to very high confidence that the globally averaged net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W/m².

II. DIRECT OBSERVATIONS OF RECENT CLIMATE CHANGE

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy rainfall and snowfall, heat waves, and the intensity of hurricanes.

Observed impacts include, but are not limited to:

- Eleven of the last twelve years rank among the twelve hottest on record.
- The ocean has warmed to at least 9750 feet depth and is absorbing more than 80% of the heat added to the climate system.
- Global sea level rise has accelerated.
- Mountain glaciers and snow cover have declined on average in both the northern and southern hemispheres.
- Average Arctic sea extent ice has shrunk by 20% at its summertime minimum since satellite observations began in 1978.
- More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics.

Some aspects of climate have not been observed to change. For example, there are no clear trends in Antarctic sea ice extent or the flow rate of the Gulf Stream.

III. A PALEOCLIMATIC PERSPECTIVE

Paleoclimate information supports the interpretation that the warmth of the last half century is unusual in at least the previous 1300 years. The last time the polar regions were significantly warmer than present for an extended period was about 125,000 years ago, at which time reductions in polar ice volume led to 13-20 feet of sea level rise.

IV. UNDERSTANDING AND ATTRIBUTING CLIMATE CHANGE

Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* (greater than 90% probability) due to the observed increase in anthropogenic greenhouse gas concentrations. This is an advance since the 2001 IPCC report, which concluded that “most of the observed warming over the last 50 years is *likely* [greater than 66% probability] to have been due to the increase in greenhouse gas concentrations”.

Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes, and wind patterns.

Analysis of climate models together with constraints from observations enables an assessed likely range to be given for climate sensitivity for the first time, and provides increased confidence in the understanding of the climate system response to radiative forcing.

V. PROJECTIONS (Model Results) OF FUTURE CHANGES IN CLIMATE

For the next two decades, warming of about 0.2°C per decade is projected for the range of emission scenarios considered. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected.

Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* (greater than 90% probability) be larger than those observed during the 20th century.

There is now higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extremes and of ice.

Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized today.

Models indicate:

- It is *very likely* (greater than 90% probability) that hot extremes, heat waves and heavy precipitation events will become more frequent.
- If global average temperatures were to exceed 1.9 to 4.6 degrees C (3.4 to 8.3 degrees F) compared to pre-industrial temperatures, the Greenland ice sheet would lose mass faster than it gains, producing a net contribution to sea level rise. If sustained for thousands of years, the loss of ice would eventually lead to complete elimination of the Greenland ice sheet and contribute an additional 23 feet to sea level rise.
- It is *very likely* (greater than 90% probability) that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent.