Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

Highlights from the First Section of the IPCC Fourth Assessment Report

Note: Whenever possible exact language from the IPPC is used throughout. To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

Overview

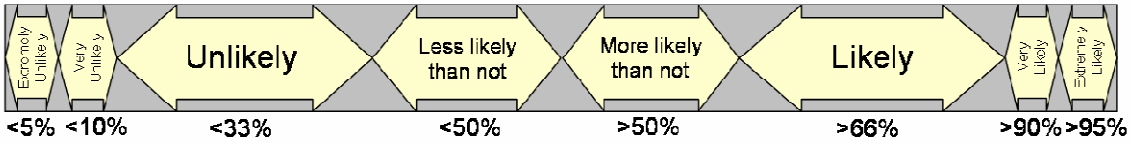
After assessing six years of climate research from the depths of the oceans to the outer reaches of Earth's atmosphere, scientists from around the world have reported on the major advances in understanding about climate change.

The new IPCC Working Group I Summary for Policymakers synthesizes the current understanding of global warming and projects future change using the most comprehensive set of well-established global climate models. The report is the first of three major studies that comprise the full IPCC Fourth Assessment, which includes input from more than 1,200 authors and 2,500 scientific expert reviewers from more than 130 countries. Subsequent reports will evaluate global warming consequences and options for reducing future warming.

For more background on the IPCC history and process visit:
www.ucsusa.org/global_warming/science/the-ipcc.html

IPCC Range of Likelihood

When the IPCC describes the likelihood of an event, the term used reflects a *percent range* of likelihood, as defined by the chart below.



Updated Assessment of the Human Impact on Climate

Evidence that human activities are the major driver of recent climate change is even stronger than in prior assessments.[1] According to the summary, there is a greater than 90 percent likelihood that increased concentrations of man-made heat-trapping gases caused most of the observed increase in global average temperatures since 1950.

Advanced Understanding of Recent Climate Change

The report also concludes that it is "unequivocal" that Earth's climate is warming "as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level."

[1] The Third Assessment Report (TAR 2001) concluded that "most of the observed warming over the last 50 years is *likely* to have been due to the increase in greenhouse gas concentration."

The report confirms that the current atmospheric concentration of carbon dioxide, a critical heat-trapping gas, "exceeds by far the natural range over the last 650,000 years." Since the dawn of the industrial era, carbon dioxide and other key heat-trapping gases have increased at a rate that is "very likely to have been unprecedented in more than 10,000 years."

Other IPCC Observations of Current Climate Change:

Temperature

- Eleven of the last twelve years rank among the twelve hottest years on record.
- Over the last fifty years, cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent.

Extreme Weather Trends (storms, precipitation, drought)

- Observations show an increase of intense tropical cyclone activity (hurricanes and typhoons) in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures. There is some evidence for increased intensity of tropical cyclone activity in some other regions. The report has found no clear trend in the annual number of tropical cyclones.
- As expected with warming and the resulting observed increases in water vapor, the frequency of heavy precipitation events has increased over most land areas. Between 1900 and 2005, long-term trends show significantly increased precipitation in eastern parts of North and South America, northern Europe and northern and central Asia.
- Between 1900 and 2005, drying has been observed in the Sahel (the boundary zone in Africa between the Sahara desert and the more fertile region to the south), the Mediterranean, southern Africa, and parts of southern Asia.
- More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics.
- Droughts have been linked to changes in sea surface temperatures and wind patterns and decreased snowpack and snow cover.

Melting of Frozen Regions

- The maximum area covered by seasonally frozen ground has decreased by about 7 percent in the Northern Hemisphere since 1900, with a decrease in spring of up to 15 percent.
- Mountain glaciers and snow cover have declined on average in both hemispheres.
- Satellite data since 1978 show that arctic sea ice extent during the summer has shrunk by over 20 percent.

Sea Level Rise

- The world's oceans have been absorbing more than 80 percent of the heat added to the climate, causing ocean water to expand and contributing to sea level rise.
- Melting glaciers and ice caps, and losses from the Greenland and Antarctic ice sheets have contributed to recent sea level rise.

Refined Projections of Future Climate Change

Projected climate change for the end of the 21st century depends on the level of future emissions. The IPCC used six defined emission scenarios, plugging each scenario into sophisticated climate simulation computer programs.

Even if we act today to reduce our emissions from cars, power plants, and other sources, past emissions will commit us to more warming since they stay in the atmosphere for decades. The report concludes that if we take no action to reduce emissions, there will be twice as much warming over the next two decades than if we had stabilized heat-trapping gases at 2000 levels.

Other IPCC Projections:[2]

Temperature

- The **full range** of projected temperature increase is 1.1 to 6.4 °C (2 to 11.5 °F)
- The **best estimate range**, which reflects the center point of the lowest and highest emissions scenarios, is 1.8 to 4.0 °C (3.1 to 7.2 °F).
- Warming is expected to be greatest over land and at most high northern latitudes, and least over the Southern Ocean and parts of the North Atlantic Ocean.

Extreme Weather Trends (storms, precipitation, drought)

- It is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with higher peak wind speeds and more heavy precipitation associated with warmer tropical seas.
- Increases in high latitude precipitation are very likely, while decreases are likely in most sub-tropical land regions (e.g. the Middle East).
- There is a greater than *90 percent* likelihood that extreme heat, longer heat waves, and heavy precipitation events will continue to become more frequent.

Melting of Frozen Regions

- Sea ice is projected to shrink in both the Arctic and Antarctic under all simulations. Some models show that by the latter part of the 21st century Arctic late summer sea ice will disappear almost entirely.

Changes in the Ocean

- Models suggest that if global average warming 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, 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.

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[2] Future climate predictions rely heavily on the commonly referred to "climate sensitivity" test, which is based on climate model analyses together with observations and is defined as the global average surface warming following a doubling of carbon dioxide concentrations (around 550 ppm). Under this test it is likely that temperatures will increase between 2.0 to 4.5 °C (3.6 to 8.1°F) above pre-industrial levels with a best estimate of about 3.0 °C (5.4 °F).

- It is very likely that the so-called "conveyer belt ocean circulation" in the North Atlantic region will slow down during the 21st century. The average reduction estimated by the models is 25 % by 2100. However, despite such changes, Atlantic region temperatures are projected to rise due to more significant warming from increases in heat-trapping emissions.
- Increasing atmospheric carbon dioxide concentrations will lead to increasing acidification of the ocean.[3]

Clarification on the Report's Sea Level Rise Projections
It is important to understand what is and is not included in the report's sea level rise projections. There are several factors that contribute to average sea level (all of which are caused by warming) and these are assessed separately in the IPCC report. These include:

- Ocean expansion resulting from increased ocean temperature
- Meltwater runoff from mountain glaciers and small ice caps
- Meltwater runoff and calving ice blocks from the two large ice sheets (Greenland and Antarctica).

The models used by the IPCC project that by the end of this century, global average sea level will rise between 0.18 and 0.59 meters (7 to 23 inches) above 1980-1999 average sea level.

The range for projected sea level rise has narrowed since the prior IPCC assessment, which projected a range of 0.09 to 0.88 meters (3.5 to 34.6 inches). This narrower range reflects an improved understanding of some processes that influence sea level (e.g. ocean heat content). **However, the report acknowledges that other unaccounted for processes make the high end projection conservative.**

Due to current uncertainties, the IPCC notes that the following factors are **not** fully reflected in the current generation of IPCC models:

- Evidence suggests that warming tends to reduce land and ocean uptake of atmospheric carbon dioxide, increasing the portion of man-made emissions that remain in the atmosphere. This would result in further warming and cause additional sea-level rise.
- Observations record that meltwater can run down fissures and lubricate the bottom of ice sheets, resulting in faster ice flow and the calving of large ice masses into the ocean. This process directly contributes to sea level rise.

The sea level projections include observed contributions from the Greenland and Antarctic ice sheets between 1992 and 2003, but exclude future changes in ice sheet behavior because of limited understanding of how to quantify potential changes from this source. For example, the IPCC states, "if this contribution were to grow with global

[3] Projected reduction in average global surface ocean pH are between 0.14 and 0.35 units over the 21st century adding to the present decrease of 0.1 units since pre-industrial times.

average temperature change," the worst case scenario "would increase by 0.1 to 0.2" meters (3.9 to 7.9 inches). In other words, the high range for sea level rise in this example could be 0.79 meters (31 inches).