World temperatures will blow past Paris goals this decade, asserts new study

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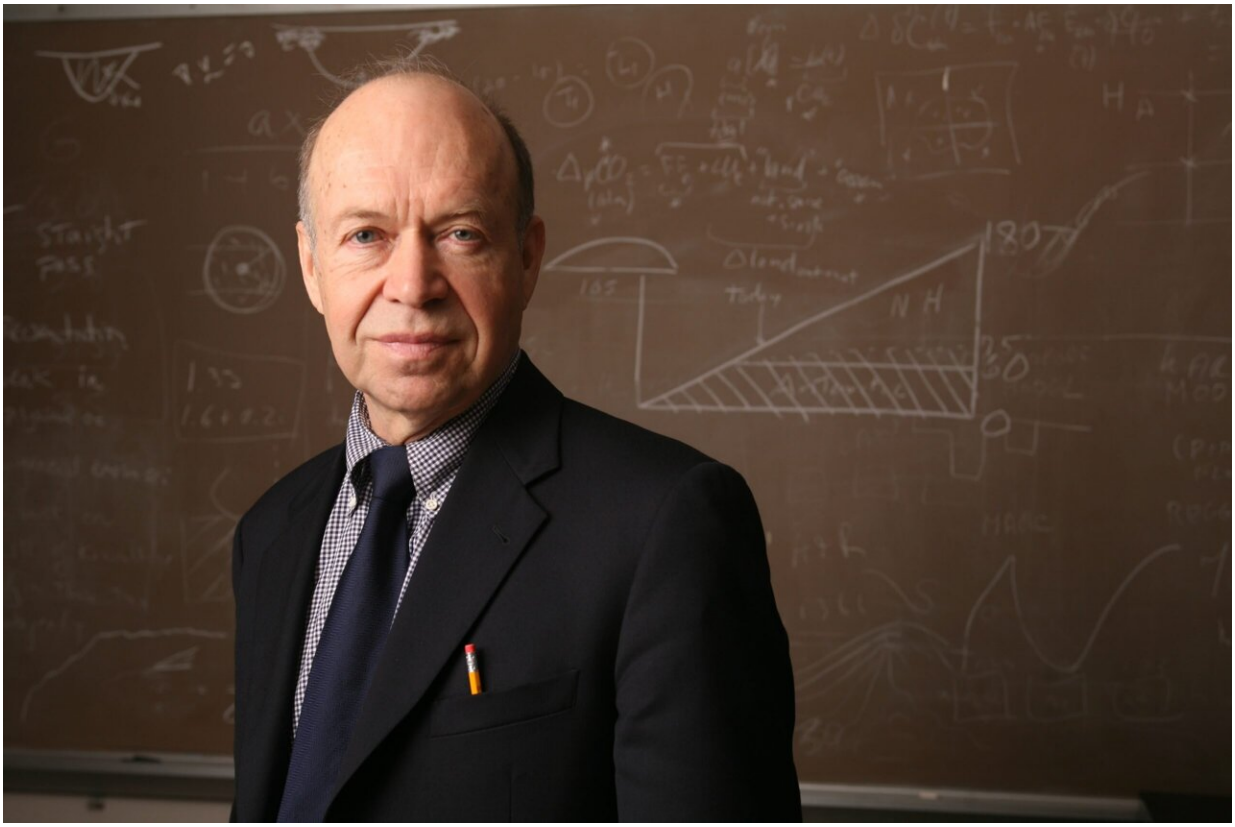

Lead author James Hansen. Credit: Bruce Gilbert/Earth Institute

According to a new paper by scientists from a dozen institutions, the world's average temperature will surpass 1.5°C above preindustrial times within the next several years—much faster than most existing forecasts.

The study goes on to say that without extreme action by the international community, temperatures will reach 2°C above preindustrial levels before 2050—also faster than most predictions.

The 1.5- and 2-degree levels are thresholds at which many scientists say the effects of climate change will become much more dire than they already are, causing killer heat waves, accelerated sea-level rise, widespread wildfires, droughts and floods. In the 2015 international Paris agreement, nations pledged to hold the increase to well below 2° and pursue efforts to limit it to 1.5°.

The study was led by James Hansen, who as a top NASA scientist famously and accurately warned Congress in 1988 that global warming would soon become evident. Hansen is now director of the Columbia Climate School's Climate Science, Awareness and Solutions center.

"The 1.5 limit is deader than a doornail," Hansen told a press conference to introduce the paper. He said he and his co-authors expect temperatures to consistently hit or exceed that level during the 2020s, then rise rapidly over the next two to three decades afterward. "The 2-degree limit is also dead, unless we take purposeful actions to reduce Earth's energy imbalance," he said.

The study, which is published in the journal *Oxford Open Climate Change*, asserts that many previous forecasts of future warming have used faulty assumptions about the sensitivity of the Earth's atmosphere to greenhouse-gas levels. They also say that recent major reductions in aerosol pollutants, which reflect energy back into space, is admitting more solar radiation to the surface, supercharging the rate of warming.

Scientists have known since the 1800s that greenhouse gases including carbon dioxide and methane warm the Earth's surface, and that their abundance changes naturally as well as from human actions. Today, due

to human emissions, carbon dioxide, the main greenhouse gas, has reached levels that have not existed for millions of years. At about 420 parts per million in 2023, levels are about 50% higher than in preindustrial times. The result has been a rise in the global average temperature of about 1.2°C, or 2.2°F.

A longstanding issue concerns how much global temperature will rise for a specified CO_2 increase. A 1979 study by the U.S. National Academy of Sciences concluded that doubling atmospheric CO_2 would likely cause global warming of between 2.7°C and 4.5°C. This was a large range, and there was additional uncertainty about a delay in atmospheric warming, caused by heat absorption by the Earth's massive oceans.

The new paper reevaluates climate sensitivity based on revised data from several recent studies on ancient climates that looked at how the Earth's temperature warmed or cooled in reaction to past variations in carbon-dioxide levels. It found that, based on those studies, climate is more sensitive to those variations than many scientists have assumed. The authors' best estimate for doubled CO_2 is global warming of 4.8°C (8.64°F), significantly larger than the 3°C best estimate of the Intergovernmental Panel on Climate Change.

The authors cite another factor: They say that much of the expected greenhouse gas warming over the past century has been offset by the cooling effect of massive emissions of human-made aerosols—fine airborne particles that reflect solar radiation. Aerosols have declined since 2010 because of reduced air pollution in China, and further since 2020, when restrictions on the sulfur content of fuels used by oceangoing cargo ships came into effect.

This aerosol reduction is good for human health, as particulate air pollution kills several million people each year and adversely affects the health of many more. However, the reduction is now beginning to

unmask greenhouse gas warming that it previously hid. "We've made a Faustian bargain here," said Hansen. "And the first Faustian payment is now due, because the reduction in aerosols is accelerating global warming."

Many scientists believe the rate of human-induced warming began accelerating after 2010, but that the signal may have been partly confused by the noise of natural year-to-year variations. The authors predict that the accelerated rate of increase will become ever more apparent very shortly, and that the 1970–2010 global-warming rate of 0.18°C per decade will increase to at least 0.27° per decade during the few decades after 2010. This, they say, is what will rapidly push the world past the Paris goals.

The study has received widespread attention, but has also proved controversial. Michael Mann, a leading climate scientist at the University of Pennsylvania, said that despite Hansen's seminal contributions to climate science and past accurate predictions, "the standard is high when you're challenging scientific understanding." Hansen's figures are "very much out of the mainstream," he said.

Bärbel Hönisch, an expert in past CO_2 levels who is based at Columbia University's Lamont-Doherty Earth Observatory, told the Guardian that she had some reservations about the authors' certainty in interpreting those levels and applying them to today. "I'd be a little more reserved, but they may well be correct," she said.

In a final section, the authors say there may be hope to keep the world from hitting the 2-degree limit, but it would take massive international cooperation on many levels. This could include placing fees on carbon emissions, support of nuclear power to complement renewable energies, geoengineering solutions including injection of sulfurous aerosols into the high atmosphere, and spraying of salty ocean water into the air by

autonomous sail boats in order to increase cloud cover.

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