

Berkeley study directly IDs climate change culprit

David Perlman, San Francisco Chronicle, 2-26-15

Scientists training their instruments on the skies have caught the world's major greenhouse gas right in the act of warming the planet, researchers reported Wednesday, providing the first direct evidence that human activity is dangerously altering the environment.

The instruments captured more than a decade of rising surface temperatures, changes that were directly triggered by the atmosphere's increasing burden of carbon dioxide, a team of scientists from Lawrence Berkeley National Laboratory and UC Berkeley reported.

That gas, whose main source is emissions from burning fossil fuels, has long been the principal culprit in global warming investigations by the vast majority of the world's climate scientists. Its rising levels in the atmosphere have been the basis for increasingly strong warnings about global warming by the Intergovernmental Panel on Climate Change, known as the IPCC.

'A technological coup'

"We have known for decades that there must be an effect, but getting a direct measurement and isolating the carbon dioxide component are a technological coup," Christopher B. Field, a senior scientist at the Carnegie Institution for Science at Stanford University who has led two major IPCC reports, said in an e-mail.

The Berkeley scientists' study, he said, provides concrete evidence for the first time of carbon dioxide's effect on global warming.

In November, the U.N. panel issued its fifth and most alarming report on the effects of greenhouse gas emissions. It warned that global ice caps are melting, Arctic sea ice is diminishing, droughts, heat waves and storms are intensifying, coral reefs are dying, and many creatures on land and in the sea are migrating toward the poles.

Documenting warming

Daniel R. Feldman, a senior scientist at the Lawrence Berkeley National Laboratory, along with other physicists and engineers at the lab and at UC Berkeley, reported Wednesday in the journal *Nature* on their findings about "radiative forcing" — the process through which carbon dioxide and other greenhouse gases in the atmosphere can block the Earth from reflecting the sun's radiant energy and actually warm the atmosphere.

The scientists used an array of extremely precise instruments that the U.S. Department of Energy has installed at its climate research facilities near Barrow, Alaska, and Lamont, Okla., to document how the warming works.

In effect, their instruments measured the amount of infrared heat radiation coming down to the Earth's surface from the sun, and the amount of heat radiation the Earth emits back up. And when the Berkeley scientists examined their data from 2000 to 2010, they found that some of the heat from Earth was being blocked by carbon dioxide in the atmosphere, and were able to calculate how much of that blocked heat was warming the planet.

Tough to visualize

The result of the warming, expressed in mathematical and engineering terms, appears tiny and difficult to visualize: It amounted to two-tenths of a watt per square meter of surface per decade. But the Earth's surface covers a lot of square meters — 510 million square kilometers, in fact, and two-tenths of a watt over 10 years can mean a lot of heat for global warming.

The IPCC's November report calculates that the Earth's entire surface has already warmed by 1.53 degrees Fahrenheit since 1882.

The Berkeley scientists measured the direct effect of carbon dioxide in the atmosphere, and after excluding all the other greenhouse gases and water vapor as sources, they reported that levels of the gas had increased in the atmosphere by 22 parts per million between 2000 and 2010.

The effects of carbon dioxide on the Earth's heat balance have long been understood by climate scientists, who have calculated them in their theories of climate change. But this is the first time the balance has been confirmed by laboratory instruments, according to Feldman and his colleagues.

“Our findings provide direct confirmation of the IPCC's findings,” Feldman said in an interview. Although he did not discuss the political controversy generated by climate-change deniers, he added, “We can hope now that people everywhere will be convinced that the IPCC's reports have been correct.”

Ken Caldeira, a physicist, climate change expert and also a senior scientist at the Carnegie Institution for Science at Stanford who was not connected to the Feldman group's research, said of their calculations that “the underlying physics is robust and was never in question.” He said the effect of carbon dioxide on global temperatures that the group measured so thoroughly “was not questioned by climate scientists.”