

Stratospheric Pollution Helps Slow Global Warming

Particles of sulfuric acid--injected by volcanoes or humans--have slowed the pace of climate change in the past decade

By [David Biello](#) | July 22, 2011 | [52](#)



STRATOSPHERIC

POLLUTER?: Eruptions like that of Soufriere Hill in Montserrat pictured here may be adding enough aerosols to the stratosphere recently to slow global warming--or coal burning in China may be the primary culprit. Image: Courtesy of NASA

Despite significant pyrotechnics and [air travel disruption](#) last year, the Icelandic volcano Eyjafjallajokull simply didn't put that many aerosols into the stratosphere. In contrast, the eruption of Mount Pinatubo in 1991, put 10 cubic kilometers of ash, gas and other materials into the sky, and cooled the planet for a year. Now, research suggests that for the past decade, such stratospheric aerosols— injected into the atmosphere by either recent volcanic eruptions or human activities such as coal burning—are slowing down [global warming](#).

"Aerosols acted to keep warming from being as big as it would have been," says atmospheric scientist John Daniel of the National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory, who helped lead the [research published online in Science](#) on July 21. "It's still warming, it's just not warming as much as it would have been."

Essentially, sulfur dioxide gets emitted near the surface, either by a coal-fired power plant's smokestack or a volcano. If that SO₂ makes it to the stratosphere—the middle layer of the atmosphere 10 kilometers up—it forms droplets of diluted sulfuric acid, known as [aerosols](#). These aerosols reflect sunlight away from the planet, shading the surface and cooling temperatures. And some can persist for a few years, prolonging that cooling.

By analyzing satellite data and other measures, Daniel and his colleagues found that such aerosols have been on the rise in Earth's atmosphere in the past decade, nearly doubling in concentration. That concentration has reflected roughly 0.1 watts per meter squared of sunlight away from the planet, enough to offset roughly one-third of the 0.28 watts per meter squared of extra heat trapped by [rising atmospheric concentrations of greenhouse gases](#) such as carbon dioxide. The researchers calculate that the aerosols prevented 0.07 degrees Celsius of warming in average temperatures since 2000.

The question is: why the increase in such aerosols? There have been plenty of smaller volcanic eruptions in recent years, such as the continuously erupting Soufriere Hills on Montserrat and Tavurvur on Papua New Guinea, which may have exploded enough SO₂ into the atmosphere. And there has been plenty of [coal burning in countries such as China](#), which now burns some 3 billion metric tons of the fuel rock per year, largely without the pollution controls that would scrub out the SO₂, as is sometimes done in the U.S. In fact, a computer model study published July 5 in *Proceedings of the National Academy of Sciences* suggested that such [SO₂ pollution in China has cancelled out the warming](#) effects of rising greenhouse gas concentrations globally since 1998. Determining whether humans or volcanoes explain more of the increase in stratospheric aerosols is the focus of ongoing research, says PhD candidate Ryan Neely of the University of Colorado, who contributed to the NOAA research.

Combined with a decrease in atmospheric [water](#) vapor and a weaker sun due to the most recent solar cycle, the aerosol finding may explain why climate change has not been accelerating as fast as it did in the 1990s. The effect also illustrates one proposal for so-called [geoengineering](#)—the deliberate, large-scale manipulation of the planetary environment—that would use various means to create such sulfuric acid aerosols in the stratosphere to reflect sunlight and thereby hopefully forestall catastrophic climate change.

But that points up another potential problem: if aerosol levels, whether natural or human-made, decline in the future, climate change could accelerate—and [China is adding scrubbing technology](#) to its coal-fired power [plants](#) to reduce SO₂ emissions and thereby minimize acid rain. In effect, fixing acid rain could end up exacerbating global warming. China "could cause some decreases [in stratospheric aerosols] if that is the source," Neely says, adding that growing SO₂ emissions from India could also increase cooling if humans are the dominant cause of injecting aerosols into the atmosphere. On the other hand, "if some volcanoes that are large enough go off and if they are the dominant cause [of increasing aerosols], then we will probably see some increases" in cooling.