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News

How aircraft emissions contribute to warming

Aviation contributes up to one-fifth of warming in some areas of the Arctic.

Rex Dalton

The first analysis of emissions from commercial airline flights shows that they are responsible for 4–8% of surface global warming since surface air temperature records began in 1850 — equivalent to a temperature increase of 0.03–0.06 °C overall.

The analysis, by atmospheric scientists at Stanford University in Palo Alto, California, also shows that in the Arctic, aircraft vapour trails produced 15–20% of warming.

The results of this analysis are likely to be studied widely as nations attempt to address the impact of commercial aviation on global warming. There are around 35 million commercial airline flights every year. Studies have been conducted in Europe, with airlines coming under increased pressure as European Union leaders consider levying a carbon tax on aircraft emissions. But little research has been conducted on the topic in the United States.

Aircraft emissions could be having a dramatic effect on the warming of the Arctic.

A. Magurean/iStockphoto

Previous studies have only estimated the impacts of commercial aviation, but this is the first use of actual emissions data — from 2004 and 2006 — to calculate warming from such flights, says Mark Jacobson, a Stanford engineer who presented the analysis on 17 December at the American Geophysical Union's annual meeting in San Francisco, California.

For the latest study, Jacobson and his team developed a model for aircraft emissions that accounts for atmospheric composition, cloudiness and the physical properties of emissions, particularly of black carbon — a major part of soot.

In his presentation, Jacobson explained how the model was applied to a nine-year simulation covering 2004 to 2013, after breaking up flight routes into 300-kilometre-square grids for analysis. The model was able to calculate the characteristics of vapour trails based on the actual particulate size of emissions and their evolution over time.

Cloudy outlook

Many previous studies have assumed that the impact of aircraft emissions was the same everywhere. But the new analysis reveals that aircraft emissions increased the fraction of cirrus clouds where vapour trails were most abundant, and actually decreased the cirrus fraction in several locations by increasing the temperatures in the lower atmosphere, reducing the relative humidity in such locations.

If black-carbon emissions from aircraft could be reduced 20-fold, warming would be halted and a slight cooling would occur from plane-created vapour trails, Jacobson says.

The team's study is being peer reviewed and is expected to be published soon, Jacobson added.

David Fahey, of the Earth System Research Laboratory in Boulder, Colorado — part of the National Oceanic and Atmospheric Administration — says that studies such as Jacobson's are important to fill the gaps in aircraft-emissions data following the nation's previously "muddled" research course.

Fahey says that now European leaders are calling for carbon taxes to be levied on each commercial airline flight, the United States is being driven to catch up on aircraft-emissions research. Some of the EU proposals suggest taxing a flight for emissions along its entire route. This is "absurd", says Fahey. For a more realistic levy, high-quality research is needed on the actual impact of such emissions, he adds.

Comments

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Jacobsen's 'models' don't correlate to empirical data. The 911 event and impact on surface temps is a fact. http://archives.cnn.com/2002/TECH/science/08/07/contrails.climate/index.html. That showed a 1.1C INCREASE in temp. Jacobsen's model shows a 0.06C impact, not even measurable. Additionally, Jacobsen's model is based off 1850 start point when, again a fact, the Little Ice Age [LIA] was just ending.

Garbage in, garbage out. You can create a model to say anything you want.

Posted by: **Dave Peach** | 22 Dec, 200

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Posted by: **Dave Peach** | 22 Dec, 200

Reply to comment by Dave Peach: the link he provides does NOT report a 1.1 C increase in temperature. To the contrary, it explicitly states "whether the jet clouds have a net effect on global warming remains unknown". It is only the variability of temperature which increased after 9/11 due to the lack of contrails – quite plausible since the trails act as atmospheric filters just as ordinary clouds do, dampening the temperature fluctuations on the surface.

Posted by: **Holger Lange** | 22 Dec, 200

Dave, I think you're misinterpreting the results of the post-9/11 study. The CNN article (which summarizes **this Nature paper**) states that "during the three-day commercial flight hiatus . . . the *variations* in high and low temperatures increased by 1.1 degrees Celsius (2 degrees Fahrenheit) each day. . . . *While the temperature range is significant, whether the jet clouds have a net effect on global warming remains unknown.*" (emphasis added). Thus the post-9/11 study found a trend in the *spread* between the daily high and low temperatures, which does not necessarily imply a trend in the *average* temperature (which is the metric for global climate change).

Posted by: **Elson Liu** | 22 Dec, 200

No doubt there is gaseous and particiulate pollution from aircraft engines, but acoustic pollution also needs to be addressed. Airplanes of all sizes, for the benefit of a miniscule percent of the human population, disturb, annoy, and quite likely injure the health of a very large percentage of all living organisms

Posted by: **Leif Lauritzen** | 22 Dec, 200

maybe the assgas from polar bear also contribute to the warmming of our planet! every thing have two facets,"jet clouds" also could reflect light from sun away, which may dampen the temperature.

Posted by: **jiaxin liang** | 22 Dec, 200

I've been a sailplane pilot for 32 years, including two extended stays in the UK. I often flew from a site near Oxford. On days when cirrus clouds would persist, the contrails of jets flying to European destinations would spread and cut the available 'lift' by half. If 600 feet per minute vertical development was forecast, we'd only encounter 300 feet per minute. The 'contrail cirrus' clearly scattered the sunlight, made it more diffuse, and probably reflected some percentage. Less vertical development meant less vigorous atmospheric mixing, smaller cumulus clouds, and dampened our soaring performance as well. The diffuse nature of the light didn't really impact the forecast maximum temperature for the day, but I suspect the less vigorous mixing in the lower atmosphere resulted in a lower inversion and hazier conditions which absorbed the heating. If we could fly north to clear the 'contrails cirrus' influence, then conditions would be as forecast.

Posted by: **Frank Whiteley** | 22 Dec, 200

It would be interesting to see if the effect of contrails can be linked to the apparent reduction in the rate of warming during the last decade. In addition to the general growth in avaiation, there has been a large increase in the use of regional jets during that period with a greater propensity to produce contrails than lower flying turbo-props.

Posted by: **Forlorn Hope** | 23 Dec, 200

Interesting if unscientific graph of global temp and aviation fuel use:
http://i629.photobucket.com/albums/uu20/blouis79/globaltemp_aviationfuel.png

Commentary here:
http://chiefio.wordpress.com/2009/12/15/of-jet-exhaust-and-airport-thermometers-feed-the-heat/

Posted by: **Brad Louis** | 24 Dec, 200

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