Probing Question: Does commercial jet traffic affect climate?

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By Katie Greene
Research/Penn State

It's hard to dispute that car and truck emissions affect the environment. Tail pipes cough out a brew of gases that contribute to smog, ground-level ozone and global warming. But what about jet pollution?

Hundreds of high-flying jets crisscross the country every day, sometimes leaving behind white streaks called contrails. This happens because during fuel combustion, jets emit soot and volatile molecules such as sulfuric acid. Water vapor present in the atmosphere collects around these particles and freezes. Thus, when jets mark up the sky, they're actually leaving lines of ice crystals, similar to wispy, high-altitude cirrus clouds.

Is this atmospheric graffiti a problem? Research by Penn State geography professor Andrew Carleton suggested it could be. Contrails "can extend the natural cirrus cover," Carleton explained, and unlike most clouds, cirrus tend to warm the surface overall because they trap heat more than they reflect the sun's radiation. "This is a concern to climate scientists because it could mean that a lot more contrails would make global warming worse."

Although scientists had suspected that contrails affect regional temperatures, there was no way to truly test the idea until the terrorist attacks on Sept. 11, 2001. In the enforced no-fly period following the collapse of the World Trade Center, air traffic was completely stopped for three days and scientists were able to directly compare temperatures logged in the presence of contrails against temperature data collected with contrail-free skies.

"I remember walking to and from my office (during that time) and thinking how incredibly clear the skies were," recalled Carleton. He mentioned this to a colleague and former doctoral-degree student of his, David Travis of the University of Wisconsin, who had noticed the same thing. "Then we started thinking that we should look at the temperature conditions" during those days in September and compare them to years past, Carleton said.

Looking at daytime highs and nighttime lows, Carleton and Travis found the average daily temperature range across the no-fly period to be almost 2 degrees Fahrenheit larger than when jets do fly. This implies, Carleton explained, that contrails lower daytime maximum temperatures and increase nighttime low temperatures -- probably in the same way that cirrus clouds do, by blocking some solar radiation from reaching earth's surface during the day and insulating against heat loss at night.

Since finding this association, Carleton has used contrails as a sort of metric for measuring meteorological and climatic change. Because these jet signatures only can form when the upper atmosphere is humid and cold, they mostly appear over the Midwest and Northeast. Interestingly, noted Carleton, since the 1970s the frequency of contrail formation has outpaced the increase of air traffic in these areas. If this trend continues, he said, it could further decrease daily temperature ranges and even evaporation for those regions, a change that could be detrimental to certain trees,

plants or insects sensitive to temperature and moisture changes.

Will such climate change prompt airlines to seek to reduce jet emissions, similar to automotive companies?

"Given the financial problems of the larger airlines in recent years, contrails are not likely to gain their attention," Carleton said. But governments in Europe and Britain "where jets also hash mark the sky" are becoming concerned, he said. Some steps that could cut down on contrails, he suggested, would be reducing the amount of sulfur in jet fuel and re-routing flight paths either to lower altitudes, where the air is warmer or higher altitudes, where it's often dryer.

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