Albion Monitor / News

Are Jet Plane Trails Affecting the Climate?

Can wispy plumes of jet exhaust affect climate?

With more than 62 million commercial and military flights weaving trails of jet exhaust across the skies above the United States each year, that's an emerging question on the radar screens of some climatologists.

And the short answer, according to Steven Ackerman, a University of Wisconsin professor of atmospheric science, is that jet exhaust plumes -- commonly referred to as contrails -- can indeed influence regional climate.

Addressing scientists at a meeting of the American Geophysical Union, Ackerman detailed the results of a year-long study of contrails and their fate in the upper atmosphere.

"Contrails are of concern in climate studies because increased jet traffic may result in an increase in cloud cover," said Ackerman. "It's been estimated that in certain heavy air-traffic corridors, cloud cover has increased by as much as 20 percent."

Contrails, in essence, are a type of cloud, formed by two parcels of air -- warm, wet air from the jet exhaust and the frigid air of the upper atmosphere. The process, said Ackerman, is analogous to seeing one's breath on a cold day.

There are two broad areas of concern when it comes to contrails, he said: One, are they changing the chemistry of the upper atmosphere? And, two, are they responsible for increased

regional cloud cover, a phenomenon that could disrupt the radiation balance, and thus the climate, of a region?

Ackerman and his colleagues, supported by the National Science Foundation and NASA, have been focusing on the latter question for the past year. The Wisconsin scientists are exploring the geometry and fate of contrails in a set of field experiments employing four different aircraft. One lays down a contrail, the second tailgates and samples the contrail at close range, the third observes from an intermediate distance and the fourth high-flying aircraft looks down on the contrail much like a satellite would.

May contribute to the formation of cirrus clouds, now being implicated as an important factor in long-term regional climates

Depending on the conditions in the upper atmosphere, Ackerman said, some contrails may be short lived while others can last for many hours, spread out and cover large portions of the sky. Under some circumstances, contrails don't form at all.

And, he said, contrails appear to be different than other types of ice crystal-based clouds, such as thunderstorms, mountain wave clouds and cirrus clouds. The field experiments indicate that contrails process infrared radiation differently. Those differences, Ackerman suspects, arise from the varying cloud particle sizes and shapes in contrails.

Clouds of all kinds, including contrails, affect weather and climate because they can both reflect the sun's radiation back into space, and trap the infrared radiation emitted by the surface of the Earth.

"If contrails spread out, then they can modify the energy balance of a region," Ackerman said. "But how it affects the energy balance is not just a function of how much cloud is up there, but what kind of cloud is up there."

All clouds are composed of water, and at high altitudes the water that makes up a cloud exists in the form of ice crystals. A key issue of contrails, which are formed in the cold upper

atmosphere, said Ackerman, is the size of the ice crystals that make up the contrail.

"What we don't know about contrails is, are they big particles or small particles? The smaller the ice crystals, the more efficient the reflector," he explained. "They may not only be modifying energy balance, but how energy is distributed."

Another unanswered question, according to Ackerman, is whether contrails feed other types of cloud formation processes. They might, for example, contribute to the formation of cirrus clouds, thin high-altitude clouds that are only now being implicated as an important factor in long-term regional climates.

But are contrails, a relatively small percentage of the clouds in a given area, a significant enough phenomenon to affect climate?

"If we are going to change the climate of a region," said Ackerman, "we're going to do it indirectly," by setting a series of events into motion. "We've got planes in the upper atmosphere and we're changing things. But how big is that effect? They're small clouds to begin with, but they grow and they can stay around for a long time."

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Front Page