Lightning-produced radiation a potential health concern for air travelers

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New information about lightning-emitted X-rays, gamma rays and high-energy electrons during thunderstorms is prompting scientists to raise concerns about the potential for airline passengers and crews to be exposed to harmful levels of radiation.

Scientists at the Florida Institute of Technology, University of California, Santa Cruz and the University of Florida have estimated that airplane passengers could be exposed to a radiation dose equal to that from 400 chest X-rays if their airplane happens to be near the start of a lightning discharge or related phenomena known as a terrestrial gamma ray flash.

The big unknown: how often — if ever — commercial airliners are exposed to these thunderstorm events, because the bursts of radiation

occur only over extremely brief periods and extend just a few hundred feet in the clouds.

"We know that commercial airplanes are typically struck by lightning once or twice a year," said Joe Dwyer, professor of physics and space sciences at Florida Tech. "What we don't know is how often planes happen to be in just the right place or right time to receive a high radiation dose. We believe it is very rare, but more research is needed to answer the question definitively."

Dwyer is the lead author of a paper about the research set to appear in the *Journal for Geophysical Research — Atmospheres.* Seven researchers from Florida Tech, UC Santa Cruz and UF contributed to the paper. "Estimation of the fluence of high-energy electron bursts produced by thunderclouds and the resulting radiation doses received in aircraft." It is free and downloadable online from the journal's "papers in press" page. The link is www.agu.org/journals/pip/jd/2009JD012039-pip.pdf .

The authors did not measure high radiation doses directly with airplanes. Instead, they estimated radiation based on satellite and ground-based observations of X-rays and gamma rays.

The authors "combined observations of lightning-produced X-rays and gamma rays with computer models of the movement of high-energy particles to estimate the amount of radiation that could be produced within, or very near, thunderclouds during lightning storms," said Hamid Rassoul, a co-author and senior researcher from Florida Tech.

The observations included those made from orbiting satellites of "terrestrial gamma-ray flashes," or TGFs, mysterious phenomena that appear to originate within thunderstorms at the same altitudes used by jet airliners. They also included measurements of X-rays and gamma rays from natural lightning on the ground, as well as artificial lightning

triggered with wire-trailing rockets fired into storm clouds. Researchers believe the phenomena are linked, because both produce high levels of gamma rays and X-rays and occur along with the actual lightning flash.

The scientists concluded the radiation in a football field-sized space around these lightning events could reach "biologically significant levels," up to 10 rem, according to their paper.

"If an aircraft happened to be in or near the high-field region when either a lightning discharge or a TGF event is occurring, then the radiation dose received by passengers and crew members inside the aircraft could potentially approach 10 rem in less than one millisecond," the paper says.

Ten rem is considered the maximum safe radiation exposure over a person's lifetime. It is equal to 400 chest X-rays, three CAT scans or 7,500 hours of flight time in normal conditions. All airplane passengers are exposed to slightly elevated radiation levels due to cosmic rays.

While the research raises obvious concerns, the scientists stressed that they don't know how often the high-radiation events occur — or how often planes are nearby enough to expose passengers and flight crews to potential danger.

David Smith, an associate professor of physics at UC-Santa Cruz, said recent airborne research suggests the incidents are rare. Flying aboard a National Science Foundation/National Center for Atmospheric Research aircraft this past summer in Florida, Smith and several of the other researchers used a highly sophisticated instrument to measure gamma ray flashes from thunderstorms. Over the course of several flights, they were only able to detect one such flash, at a safe distance from the plane.

"These observations show that although thunderstorms do occasionally

create intense gamma-ray flashes, the chance of accidently being directly hit by one is small," Smith said.

Martin Uman, another author and a distinguished professor of electrical and computer engineering at UF, noted that airline pilots typically seek to avoid flying through storms.

However, he said, the fact that commercial planes are struck once or twice a year suggests more inquiry is needed. He said he would recommend to the Federal Aviation Administration that it place detectors aboard planes capable of measuring the storm-related, brief and intense radiation bursts to determine how often they occur. He also said more research on the phenomena that generates the bursts is clearly needed.

"What we need to do is supply the right kind of detectors to a lot of planes, and see if this ever happens," he said. "We also need to spend more time looking at gamma and x-ray radiation from lightning and thunderstorms and trying to understand how it works."

The paper drew on data from numerous observations and experiments, including experiments involving artificial "triggered" lightning at UF/Florida Tech International Center for Lightning Research and Testing at the Camp Blanding Army National Guard Base near Starke, Florida. UF and Florida Tech researchers at the center were the first to identify X-ray emissions from triggered lightning.

Source: University of Florida (news : web)

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