Engineers are first to measure lightning-caused polluting gas

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A flash of light, a boom of thunder, a puff of smog? Researchers have long known that lightning produces lots of nitrogen oxide. Power plants and cars also give off the gas, which is a big ingredient in smog.

Now, engineering researchers have made the first direct measurements of the amount of nitrogen oxide produced during an actual lightning strike – a feat likely to be important in separating human and natural contributions not only to air pollution, but also to global warming.

Engineers from the University of Florida and Uppsala University in Sweden triggered lightning by firing wire-trailing rockets into storm clouds at UF's lightning research and testing center in rural North Florida.

Using a metal rod, they ran this lightning into a sealed chamber that contained another metal rod less than 2 inches away. After the lightning "jumped" between the rods, the engineers pumped out the air in the chamber and analyzed it, measuring the precise amount of nitrogen oxide produced by the zap of chambered lightning. They repeated the experiment two more times.

Their findings appear in the February issue of the journal *Geophysical Research Letters*.

When produced by human activities, nitrogen oxide is a byproduct of combustion by automobiles, power plants and other sources.

At low levels, it is the principal ingredient in smog. Higher up, in the troposphere, nitrogen oxide plays a role in regulating the amount of ozone, which at that altitude acts as a greenhouse gas that warms the planet. At still higher altitudes, in the stratosphere, ozone forms a protective layer against the sun's harmful rays.

While it is not surprising that the engineers disocvered nitrogen oxide, their findings do upset the conventional wisdom in an important way, said Vladimir Rakov, a UF professor of electrical and computer engineering and the principal investigator on the project.

Atmospheric scientists had long believed that lightning produced the most nitrogen oxide during the so-called "return stroke" phase, when lightning moves from ground up into a cloud.

In fact, Rakov said, the engineers concluded that the lightning produced the most nitrogen oxide during a later phase: the steady stroke. This phase is visible during nighttime storms, when lightning sometimes seems to hang in the sky.

That's important because the majority of lightning – at least 70 percent – occurs within clouds and never touches ground.

So, the results could mean that the models atmospheric scientists have been using to determine the amount of lightning-produced nitrogen oxide are not accurate. That suggests that the role of lightning in smog and global warming should be reassessed, the UF researchers said.

"There's a paper in the literature that says the majority of the nitrogen oxide in the southeastern U.S. doesn't come from power plants – it comes from lightning," said Martin Uman, a professor of electrical and computer engineering and director of UF's International Center for Lightning Research and Testing. "But that paper is controversial."

“What we’ve contributed is an input number that is needed for the overall calculation of nitrogen oxide, which will help answer these kinds of questions.”

Mahbubur Rhaman of Uppsala University is the lead author of the *Geophysical Research Letters* paper on the project, which was one of several projects funded with a grant from the National Science Foundation.

Source: University of Florida