Google Street View cars are eyes on the ground for urban methane leaks

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Some Google Street View cars have been specially equipped with methane analyzers to detect methane lakes from natural gas lines. Credit: EDF

A set of Google Street View mapping cars, specially equipped with cutting-edge methane analyzers, are allowing Colorado State University

researchers to "see" invisible methane leaks from natural gas lines beneath our streets.

The technical and computational challenges of measuring methane, and the complex methodologies used to collect, analyze and publicize the data, are detailed in a new paper in the journal *Environmental Science and Technology* March 22.

The groundbreaking project is led by Joe von Fischer, CSU associate professor in biology, in partnership with the non-profit Environmental Defense Fund (EDF), and Google Earth Outreach. von Fischer's CSU co-authors include researchers from statistics (Dan Cooley), atmospheric science (Russ Schumacher), and soil and crop sciences (Jay Ham), as well as experts from University of Northern Colorado and the nonprofit science collective Conservation Science Partners.

Data from the project are helping utilities, regulators and advocacy groups reduce wasteful and environmentally damaging leaks faster and more cost effectively.

Besides being the main ingredient in natural gas, methane is also a potent greenhouse gas, with over 80 times the warming power of carbon dioxide over a 20-year timeframe. Growing awareness of this climate risk has spurred new interest in finding and fixing low-level leaks throughout the natural gas supply chain, including local utility systems, where many low-level leaks can persist for many years. That need has spawned a new kind of science.

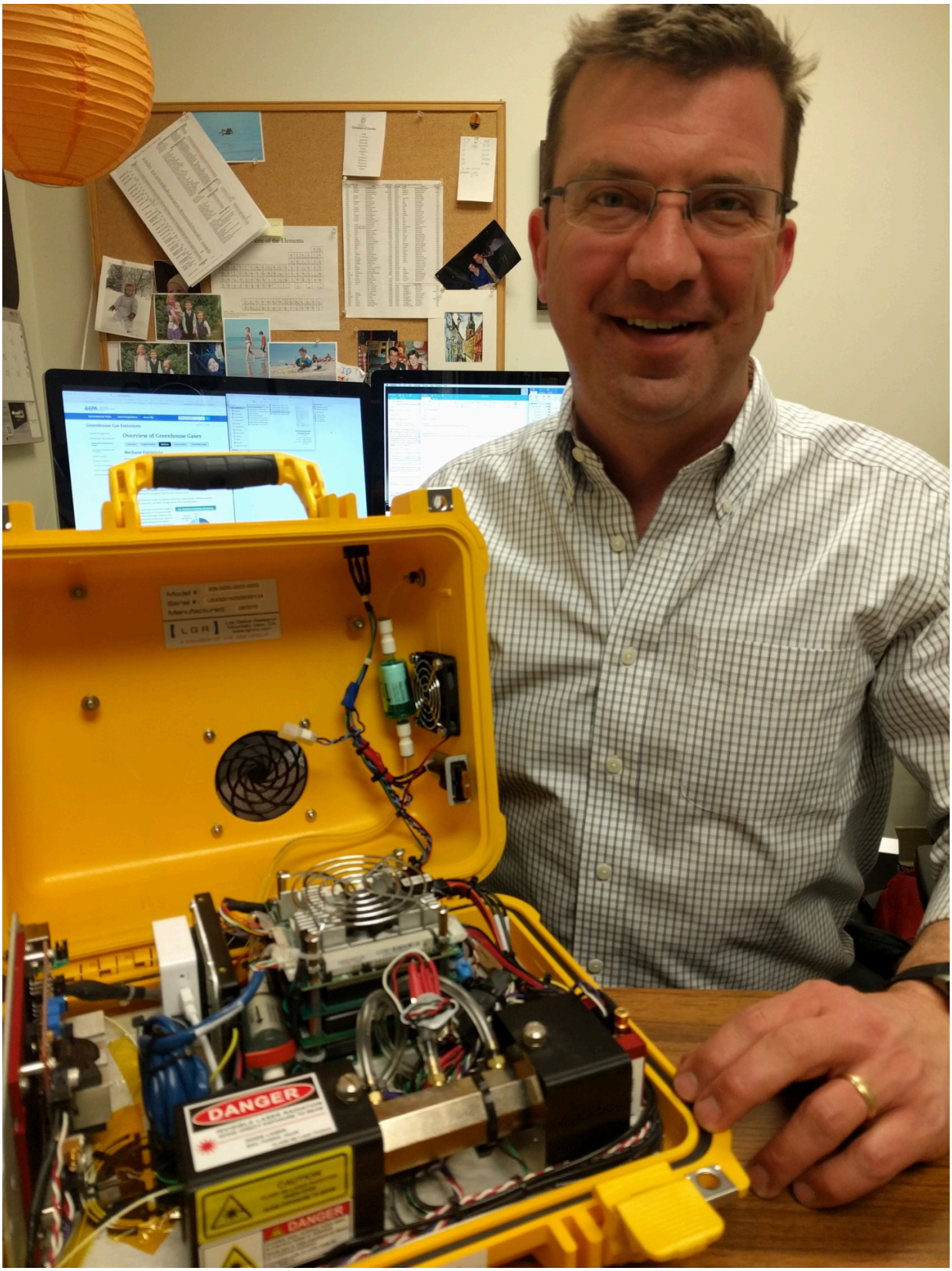
"This is a huge challenge that almost nobody had been thinking about. Now we're finding out just how widespread these leaks are," von Fischer said. "The faster you fix them, the bigger the environmental benefits are. But utilities and regulators didn't have the data to focus their efforts. That's where we come in. Our goal is to make it faster, cheaper and

easier to find and measure methane leaks from natural gas lines to help accelerate crucial repairs."

For the Google project, von Fischer and colleagues were especially eager to identify and quantify methane leaks from the nation's urban areas, where natural gas distribution pipelines lie several feet below the ground. Their EDF Google Street View project is a first-of-its-kind, comprehensive inventory of methane leak sources within cities. The goal is to shine a powerful light on this previously invisible, hard-to-define problem.

A chief motivation of the project is to help utility companies and governments prioritize leak repairs based on the magnitude of emissions. The researchers calculate that fixing the largest 8 percent of leaks would cut pipeline methane emissions by 30 percent. The New Jersey utility company PSE&G has approved almost $1 billion worth of upgrades directed in part by the CSU researchers' data.

The baseline technology that's allowed the project to bloom is an infrared laser methane analyzer. These mobile instruments, which didn't even exist a decade ago, can identify plumes of methane gas in real time, without the need for a gas chromatography analysis in the lab.


Overview of Greenhouse Gases
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This is Colorado State University researcher Joe von Fischer with a laser-based methane analyzer, similar to the ones being used in the Google Street View cars. Credit: Colorado State University

"The air contains gases that make it look foggy in the infrared spectrum," von Fischer explained. "The laser can scan through colors of infrared light and 'see' how much methane is present."

At the core of the effort is a set of algorithms and protocols that provide accurate accounting of methane leaks, including the size of the plumes.

Before they took their technology into Street View cars, the researchers first ran preliminary tests with research vehicles driven around campus and on the tarmac at the Christman air field. This included controlled releases of methane in both open and urban environments.

The project has involved designing optimal routes for the Google drivers, while keeping the drivers' interaction with the equipment passive and simple. The researchers have also developed methods for screening out false positive readings - for example, how to tell the difference between a true methane leak, and a wayward reading from a landfill or nearby power facility.

For von Fischer, a classically trained ecosystem ecologist, the project has stretched him as a scientist and has catalyzed interactions with a dizzying array of disciplines. "I regularly talk with lawyers, industry people, statisticians, computer scientists, atmospheric physicists, Google....this is just a part of my life now," he said.

At present, there are four Google Street View cars in various cities carrying the CSU methane analyzers, as von Fischer and colleagues'

work continues. The drivers are instructed to drive all the roads in a predetermined area to capture leak data that the CSU researchers download, analyze, and upload to a public website hosted by EDF.

To deal with the enormous streams of data the project produces - about 2,000 data points per minute - CSU computer science researcher Sangmi Pallickara is creating a cloud-based platform to manage, store and present the data.

So far, the CSU methane analyzers have provided leak maps of Boston; Burlington, Vermont; Chicago, Dallas, Indianapolis, Jacksonville, Los Angeles, Mesa, Arizona; Pittsburgh; Staten Island, New York; and Syracuse, New York.

Among other things, they've reported that, on average, Boston, Staten Island and Syracuse - cities with old, corrosion-prone distribution lines - had leaks that released 25 times more methane per kilometer of road (2 liters of methane per minute per kilometer) than Burlington and Indianapolis (0.08 liters of methane per minute per kilometer).

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