Climate Watchdog

By John Benson

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1. Introduction

If an information source that I plan to use for a paper is about climate change, then I've probably written about it before. From the title, you can probably tell that this paper is about that subject, and I have, thrice. The first paper was in 2021:

Damn Satellite: *It was just three years ago. Jerry Brown was in his second Governorship, and was in a running battle with the then president (I forget his name).*

California Gov. Jerry Brown started the week by signing a pair of actions to get his state to use nothing but electric power drawn from green sources like wind and solar by 2045. He ended the week Friday with a surprise: The state would launch its "own damn satellite" to track down greenhouse gas emitters who fuel global warming.

"In California, with science under attack, in fact we're under attack by a lot of people, including Donald Trump. But the climate threat still keeps growing," Brown told delegates at Moscone Convention Center, near San Francisco's financial district. "With science still under attack, we're going to launch our own satellite, our own damn satellite, to figure out where the pollution is."

Now California and other like-minded organizations have put together a consortium to launch our "damn satellite," and this includes funding. The program is called Carbon Mapper.

This post will provide a summary of this program.

https://energycentral.com/c/ec/damn-satellite

The above started out as a single paper, but I obviously needed to follow up (also in 2021):

Damn Satellite, Part 2 – Damn Airplane & CH_4: *California and other like-minded organizations have put together a consortium to launch our "damn satellite," and this includes funding. The program is called Carbon Mapper.*

However, these satellites will only identify large sources at large-scales, so I decided to drill down to scales where significant sources of one problematic greenhouse gas (GHG), methane (CH_4) can be identified.

https://energycentral.com/c/ec/damn-satellite-part-2-%E2%80%93-damn-airplane-ch4

With me, one good follow-up frequently leads to another (in mid-2022):

Damn Satellite Part 3: Super-emitters and Ultra-emitters: *The Permian super-emitters have now been located with better precision at the completion of a multi-year aerial survey, and additional surveys have been performed via multiple satellites.*

The other news is that the Environmental Protection Agency (EPA) has started a process to define new methane emission rules for oil and gas producers.

Also, an international consortium has identified a new class of methane Ultra-emitters.

Part 3 reports on all of the above new information.

https://energycentral.com/c/cp/damn-satellite-part-3-super-emitters-and-ultra-emitters

I think I've used up the "Damn Satellite," so I decided to try something different, even though the subject is similar. Also, the latest celebrity climate fighter is not from California. I believe he's from Tennessee.

2. Climate Trace

The carbon dioxide and methane that have such palpable effects on climate are frustratingly elusive. Even advanced satellites struggle to pinpoint plumes of the gases, which are the dominant drivers of global warming. Instead, countries assess their emissions by piecing together direct measurements, statistics on agriculture and fossil fuel use, and modeling. This week, at the United Nations's annual climate change conference in the United Arab Emirates (UAE), countries are presenting those emissions inventories to show whether they have made progress on promised cuts.[1]

Yet the figures are often misleading, according to Climate Trace, an independent watchdog that is tracking emissions based on new kinds of satellite data, together with artificial intelligence (AI). Its latest assessment, released today, shows that in 2021 Russia left out greenhouse gases equivalent to 1.5 billion tons of carbon dioxide and the United States missed 400 million tons, much of it driven by carbon dioxide and methane emissions from oil and gas operations. Overall that year, among wealthy nations required to report to the U.N., Climate Trace estimates 3 billion tons of carbon dioxide equivalent gases went unreported—some 5% of total global emissions.

Other large polluters are not yet required to submit inventories. China last reported one in 2014, but Climate Trace estimates the country's emissions have grown by 17% since then. The UAE, meanwhile, last estimated emissions of 225 million tons in 2019, but Climate Trace found at least 354 million tons for that year. "Why the difference?" asks Gavin McCormick, Climate Trace's cofounder. "Unclear."

Backed by former U.S. Vice President Al Gore, Climate Trace is a coalition of nonprofits and academics that made headlines 2 years ago with its first analysis of 72,000 of the world's largest greenhouse gas sources. Its newest assessment looks at 352 million greenhouse gas sources. "It is really incredibly powerful," Gore says. "This serves a purpose that is at the top of humanity's priority list."

Long term, Gore hopes Climate Trace will be integrated into the U.N. process. And in the meantime, it is helping less developed regions keep track of their emissions. "Especially in the industrial sector, there was much data we did not have access to," says Samanta Della Bella, general manager for climate change in the state of Penambuco in Brazil.

For Gore, Climate Trace fulfills a dream he laid out in a 1998 speech at the California Science Center, when he called for a "digital Earth." To monitor how humans are changing the planet, he called for the "automatic interpretation of imagery, the fusion of data from multiple sources, and intelligent agents that could find and link information." That goal seemed out of reach until 2020, when he first encountered McCormick's work.

[1] Paul Voosen, Science Magazine, "Al Gore's climate watchdog spots emission gaps," Dec 8, 2023, https://www.science.org/content/article/al-gore-s-climate-watchdog-spots-rogue-emissions

An economist by training, McCormick founded WattTime, a nonprofit dedicated to identifying the daily timing of renewable energy surpluses and wiring thermostats and electric car chargers to take advantage of it. Many countries do not track the ebbs and flows of energy, so his team wondered whether satellite data—imagery of steam pouring out of smokestacks or cooling-water releases into rivers, or detections of air pollutants—could identify when dirty power plants were operating, and through that activity, their emissions. Now part of Climate Trace, those estimates grew this year to some 30,000 plants, covering 90% of global capacity. "We're focusing on easy to spot things from space that make huge differences on emissions," McCormick says.

Climate Trace has also assimilated similar models for other emissions sources, creating one central estimate of emissions across all human activity. One key addition was the Oil Climate Index Plus Gas, a model developed by Deborah Gordon, a researcher at the Rocky Mountain Institute, and her colleagues that is fed by granular statistics for drilling sites, such as oil composition and weight, which help indicate the energy, and carbon dioxide emissions, needed to extract and move the fuel. The model also estimates methane leakages based on detections of gas flaring by U.S. weather satellites and readings from instruments mounted on planes and the International Space Station. The results make it clear that reported national inventories are missing a lot of methane, which is 80 times more potent at warming the planet than carbon dioxide in the short term. "Methane is the wild west," Gordon says.

For other sectors, Climate Trace enlists AI. In agriculture the three biggest emission sources are cattle and rice paddies, which give off methane; and fertilizer use, a source of nitrous oxide, another potent greenhouse gas. By training an AI to recognize cattle farms and rice paddies in satellite images, and then factoring in the number of cattle or inundated acreage, they could quickly chart their global extent and emissions. For fertilizer, meanwhile, the team is experimenting with using satellite imagery to detect crop yields, photosynthesis, and the capacity of the soil to take up nutrients, all of which can then be used to infer how much fertilizer is applied.

To estimate emissions from transportation, Climate Trace draws on an AI developed at the Johns Hopkins University Applied Physics Laboratory (APL) that analyzes infrastructure seen in satellite images. By combining imagery from Europe's Sentinel-2 satellite with roadways identified by Open-StreetMap, the researchers found that an AI could—somehow—sense the number of cars on a road, even though the satellite could not see them individually. "We don't know what it is picking out from those images to produce results," says Marisa Hughes, who leads the APL team. By adding measured emissions from cars and adjusting for the car mix of individual countries, the new version is estimating emissions for hundreds of thousands of road segments.

Funded at first by personal donations from Gore and his partners at Generation Investment Management, Climate Trace does not accept corporate or government sponsorship, and runs on a budget of $12 million. It also submits its methods to peer review, although not always in advance of putting them into operation. For now, it aims to provide a simple reality check on global emissions. But in the next few years, developing countries will be required to submit their own inventories, and Climate Trace is in discussions with the U.N. to provide those estimates for free, Gore says. "Many of these countries don't have the ability to do it, nor should they be expected to."

But some governments may be reluctant to factor in emissions identified by Climate Trace, given they have already made pledges based on flawed data, especially when it comes to methane, Gordon cautions. "There's a lot of hesitancy to reflect reality, even if they know they're wrong."

A new generation of satellites that directly sense greenhouse gases could challenge Climate Trace. Using NASA's Orbiting Carbon Observatory-3, for example, researchers have traced carbon dioxide emissions in megacities like Los Angeles to different sectors, such as highways, industry, and shipping. But ultimately, "These techniques are complementary," says Riley Duren, a remote-sensing scientist at the University of Arizona and CEO of Carbon Mapper, which next year will launch a pair of satellites designed to spot small plumes of methane and carbon dioxide.

Author's comment: Regarding Carbon Mapper, see "Damn Satellite, Part 2…" summarized and referenced in the Intro.

One thing is for certain: As Climate Trace grows more comprehensive, and its claims more definitive, it will draw more scrutiny, and opposition. But opposing countries and industries are welcome to make their case. "Our numbers are public," McCormick says. "And anyone who has different numbers will need to have a reason they're different."

3. More About Climate TRACE

First of all, trace is an acronym that stands for "Tracking Real-Time Atmospheric Carbon Emissions." This is per Wikipedia, based on a reference to Al Gore.[2]

Also, per the referenced Wikipedia Article:

Time magazine named it as one of the hundred best inventions of 2020. Their emissions map is the largest global inventory and interactive map of greenhouse gas emission sources. According to Kelly Sims Gallagher it could influence the politics of climate change by reducing Measurement Reporting and Verification (MRV) disputes, and lead to more ambitious climate pledges.

Power plant emissions are tracked by training software with supervised learning to combine satellite imagery with other open data, such as government datasets, OpenStreetMap, and company reports. Similarly large ships will be tracked to better understand emissions from international shipping.

Members of Climate TRACE include nonprofits CarbonPlan, Earthrise Alliance, Global Energy Monitor, Hudson Carbon, OceanMind, Rocky Mountain Institute and TransitionZero. Also companies Blue Sky Analytics and Hypervine. And, of course Al Gore and WattTime (see prior section).

The Climate TRACE Home Page (link below) has an interactive map of emitters. Click on the "Explore Map" button to do this. It initially comes up with a brief tutorial, then allows you to pan and zoom to a specific area. The map-view can be moved via click and drag.

https://climatetrace.org/

[2] https://en.wikipedia.org/wiki/Climate_TRACE