MethaneSat, et al

By John Benson

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1. Introduction

In 2021 and 2022 I posted a three-part series, described below.

Damn Satellite, June 2021: *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…

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

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

Damn Satellite, Part 2 – Damn Airplane & CH_4, Nov, 2021: *Now California and other like-minded organizations have put together a consortium to launch our "damn satellite,"*

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 (CH4) can be identified.

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

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…*

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

However, as of today, Carbon Mapper has still not launched any satellites, although they have made progress in developing their satellites. Go through link below.

https://carbonmapper.org

I did find one recent, post that indicated that "…Carbon Mapper is set to launch this year…" (2024)[1]

Now another party has launched a new satellite to monitor methane emissions.

SpaceX successfully launched a game-changing satellite on Monday, March 4. Called MethaneSAT, the new satellite is in orbit tracking methane leaks from oil and gas companies worldwide.[2]

[1] Nicolás Rivero, Washington Post, "A new watchdog satellite will sniff out methane emissions from space," March 4, 2024, https://www.washingtonpost.com/climate-solutions/2024/03/04/methane-satellite-public-data/

[2] Ellyn Lapointe,Catherine Boudreau, Business Insider, "SpaceX launched a satellite that Google will use to map methane leaks for all to see by the end of this year," https://www.msn.com/en-us/news/technology/spacex-launched-a-satellite-that-google-will-use-to-map-methane-leaks-for-all-to-see-by-the-end-of-this-year/ar-BB1jksTd

Methane is a critical driver of climate change. When it comes to trapping heat inside Earth's atmosphere, methane is over 28 times more powerful than carbon dioxide. Tracking methane leaks will help identify the most egregious emitters.

The Environmental Defense Fund developed MethaneSAT, and Google has partnered with the organization to create its first global methane map by the end of the year for all to see, ushering in a new era of climate accountability.

Section 2 below will cover MethaneSAT, and Section 3 will cover all of the many methane monitoring satellites in orbit, with different missions.

2. MethaneSAT

Mark Brownstein, senior vice president for energy transition at the Environmental Defense Fund (EDF) environmental advocacy group, spoke to Offshore Technology about the potential of the technology to facilitate change in the oil and gas sector.[3]

What does MethaneSAT do, and how will it spot methane leaks?

Brownstein: *MethaneSAT is a tool that's designed to provide us with comprehensive information on total methane emissions coming from the oil and gas industry. It will have the capacity to do an ongoing assessment of more than 80% of all oil and gas operations worldwide.*

Importantly, it will have a level of sensitivity that no other instrument currently has, so we will get more total data than we can currently get. We'll get it on an ongoing basis worldwide because the instrument circles the globe 15 times a day, so we will also have the ability to attribute emissions geographically.

MethaneSAT, Image from the Environmental Defense Fund, edf.org

We will be able to use this for attribution to calculate not just the total amount of emissions coming from any particular point, but also the rate of those emissions.

[3] Eve Thomas, Global Data / Offshore Technology "Q&A: how will MethaneSat help to reduce methane emissions?," March 8, 2024, https://www.msn.com/en-us/money/other/q-a-how-will-methanesat-help-to-reduce-methane-emissions/ar-BB1jAcSK

It's very much a game changer because it is so comprehensive, and it is an ongoing diagnostic and reporting tool.

How will MethaneSAT's data bring about change in the oil and gas sector?

Brownstein: *MethaneSAT has been about six or seven years in development and, alongside the effort to design, build and launch the satellite, has been an equally committed effort to enact regulation and to secure company commitments.*

We're now at a point where we have the United States, finalizing comprehensive oil and gas regulations that will be the most comprehensive and stringent in the world. We have the European Union, about to enact a set of regulations that will require not only reductions from domestic sources of emissions but also new reporting requirements for anyone selling gas into the into the Union, domestic or foreign.

We've got regulation in Canada, we've got regulation in Mexico, and MethaneSAT is going to be helpful in the implementation of those regulations, holding both companies and governments accountable for performance under those regulations.

As well, at COP28, we had over 50 companies around the world commit to reductions in the next five years that should add up to about a 90% reduction in methane emissions from those that have made the commitment. We'll be able to use MethaneSAT to assess how well those companies are doing in meeting the commitments that they made. Of course, we can also use MethaneSAT to assess how companies who have yet to sign up for those commitments are doing as well.

It is an opportunity to be able to better assess the degree to which countries and companies are making progress and reducing emissions, and where there are opportunities to improve performance in the next few years.

Why have you chosen to focus first on oil and gas operations?

Brownstein: *Methane from human activity is responsible for close to a third of the warming that our planet is experiencing right now. There is nothing that we can do that will have a more immediate impact in slowing the rate of warming that's pressing down on all of us than reducing methane pollution.*

The oil and gas industry is responsible for roughly a third of that pollution. Agriculture is also a source of emissions (largely cows and beef cattle), but also rice farming, and landfills are an important source.

However, the oil and gas industry, I think, is uniquely positioned to play a leading role. First of all, most of the oil and gas companies around the world are relatively well-capitalized and therefore have the resources to be able to tackle these emissions.

But also, methane is the key constituent in natural gas. Every molecule of methane that goes to waste in the atmosphere is one less molecule that can be put to use for energy and meeting the world's energy needs. At a time when so much of the world is scrambling to find new energy resource – either to replace that which we're no longer willing to buy from places like Russia, or, in the case of the Global South, where energy access and energy poverty is still an issue – methane abatement becomes low hanging fruit, not just to address the climate crisis, but also to address, global energy security needs.

Could MethaneSAT act as a tool to bring about change in other industries too?

Brownstein: *MethaneSAT will be able to see methane emissions from a wide variety of sources. The limitation, if there is any, is in how much data that we can download from the satellite in any given pass over radio relay stations around the globe. There's a certain amount of prioritization that we have to do just because there are limits to how much data we can import from the satellite on any given pass.*

Additionally, it's not just about the data that the satellite is collecting, it's also about the algorithms that you develop to properly interpret and attribute that data. We have done the hard work of building that for the oil and gas industry.

One of our partners in this project is New Zealand, which is devoting resources to developing tools to be able to take MethaneSAT data and use it for assessing agricultural emissions since that's a big priority of New Zealand's.

How has methane pollution been identified and quantified until now?

Brownstein: *Up until this point, we've been collectively relying on data that is being reported by companies, to countries.*

Our decision to pursue a methane satellite was built on almost a decade's worth of experience that we had doing field studies in the United States, Canada, Mexico, Europe, Australia and elsewhere using terrestrial-based technologies, airplanes, drones, handheld devices or devices posted at the fence line of facilities, so we've used a wide variety of tools.

What we know from all of those field studies that we've done is that there's no substitute for measured emissions. Companies historically have reported their emissions on the basis of engineering calculations, and – at least in the United States – we've shown that those engineering calculations serve to underreport emissions by 60%.

We expect that as we begin to gather data from MethaneSAT, what we currently understand about the total magnitude of the challenge (and what we currently understand about who is a larger emitter) may change as we get more accurate information collected from real-time assessment.

Is MethaneSAT a long-term solution?

Brownstein; *The satellite has a design life of at least five years, but with the equipment in space, design life is a conservative estimate of how long a facility how long a probe can last. Of course, there is the example of the Voyager probe, which had a very short mission, and yet continues to produce information 40 years after launch.*

There really is no telling how long the satellite will be able to produce data, but it's at least fit for purpose through the 2030 timeframe, and likely years to come after that.

Will MethaneSAT 'name and shame' the biggest polluters in oil and gas?

Brownstein; *There's no question that, with this tool, we're going to be able to better understand where the problems are and where the opportunities are to make reductions, but when I talk about accountability, I often remind folks that the student that goes to class does all the readings doesn't fear a final exam.*

We look at MethaneSAT as an opportunity for the good students in the industry to gain validation for the work that they've been doing, while using the information from MethaneSAT to prod those that would linger in the bar to get back to work.

3. One of Many, but Different Applications

On Monday afternoon, March 4 a satellite the size of a washing machine hitched a ride on a SpaceX rocket and was launched into orbit. MethaneSAT, as the new satellite is called, is the latest to join more than a dozen other instruments currently circling the Earth monitoring emissions of the ultra-powerful greenhouse gas methane. But it won't be the last. Over the next several months, at least two additional methane-detecting satellites from the U.S. and Japan are scheduled to join the fleet.[4]

There's a joke among scientists that there are so many methane-detecting satellites in space that they are reducing global warming — not just by providing essential data about emissions, but by blocking radiation from the sun.

Despite the small army of probes in orbit, and an increasingly large fleet of methane-detecting planes and drones closer to the ground, our ability to identify where methane is leaking into the atmosphere is still far too limited. Like carbon dioxide, sources of methane around the world are numerous and diffuse. They can be natural, like wetlands and oceans, or man-made, like decomposing manure on farms, rotting waste in landfills, and leaks from oil and gas operations.

There are big, unanswered questions about methane, about which sources are driving the most emissions, and consequently, about tackling climate change, that scientists say MethaneSAT will help solve. But even then, some say we'll need to launch even more instruments into space to really get to the bottom of it all.

Measuring methane from space only began in 2009 with the launch of the Greenhouse Gases Observing Satellite, or GOSAT, by Japan's Aerospace Exploration Agency. Previously, most of the world's methane detectors were on the ground in North America. GOSAT enabled scientists to develop a more geographically diverse understanding of major sources of methane to the atmosphere.

Soon after, the Environmental Defense Fund, which led the development of MethaneSAT, began campaigning for better data on methane emissions. Through its own, on-the-ground measurements, the group discovered that the Environmental Protection Agency's estimates of leaks from U.S. oil and gas operations were totally off. EDF took this as a call to action. Because methane has such a strong warming effect, but also breaks down after about a decade in the atmosphere, curbing methane emissions can slow warming in the near-term.

"Some call it the low hanging fruit," Steven Hamburg, the chief scientist at EDF leading the MethaneSAT project, said during a press conference on Friday. "I like to call it the fruit lying on the ground. We can really reduce those emissions and we can do it rapidly and see the benefits."

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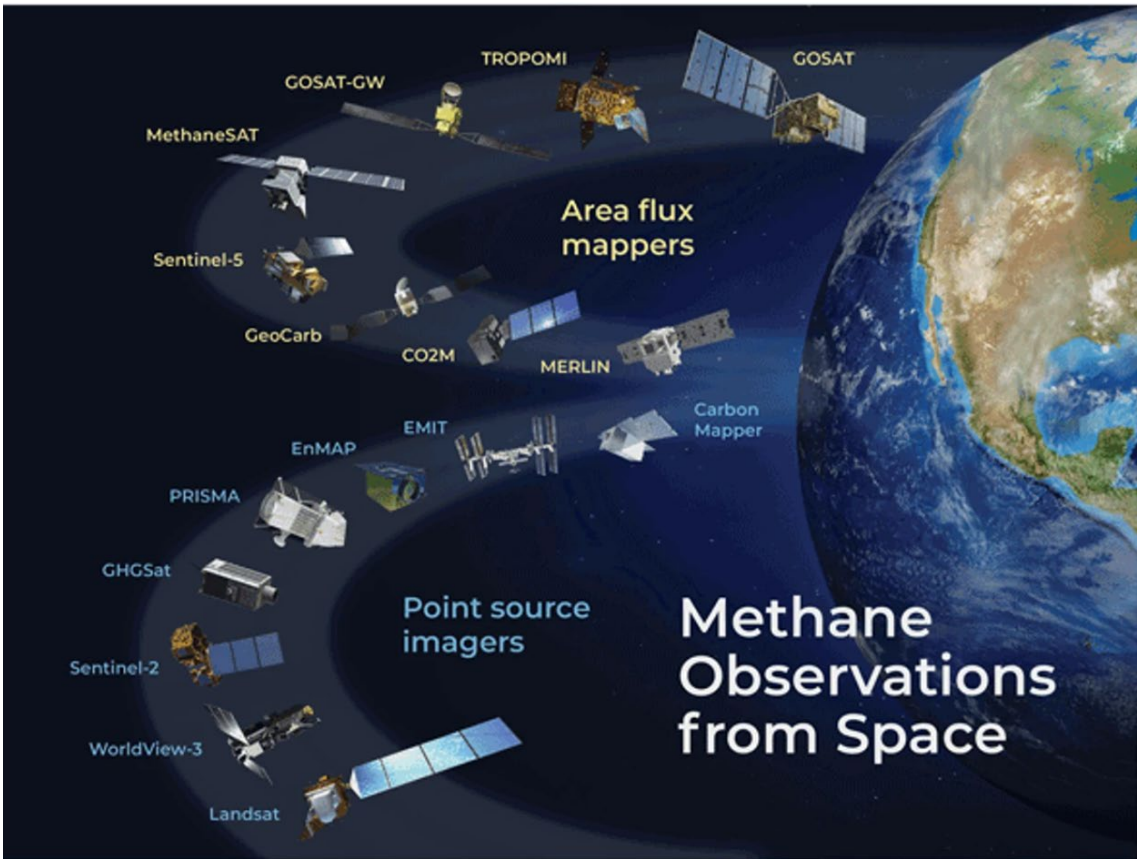
[4] Emily Pontecorvo, Heatmap, "Why Are There So Many Methane Satellites?," March 5, 2024, https://heatmap.news/technology/methanesat-edf-satellite-gosat?utm_source=mailchimp&utm_medium=email&utm_campaign=em_newsletter&utm_source=newsletter&utm_medium=email&utm_campaign=currentclimate&cdlcid=628673ca6e1a1d1211f1d747&section=reading

But in order to do that, we need a much better picture than what GOSAT or other satellites like it can provide.

In the years since GOSAT launched, the field of methane monitoring has exploded. Today, there are two broad categories of methane instruments in space. Area flux mappers, like GOSAT, take global snapshots. They can show where methane concentrations are generally higher, and even identify exceptionally large leaks — so-called "ultra-emitters." But the vast majority of leaks, big and small, are invisible to these instruments. Each pixel in a GOSAT image is 10 kilometers wide. Most of the time, there's no way to zoom into the picture and see which facilities are responsible.



Jacob, D. J., Varon, D. J., Cusworth, D. H., Dennison, P. E., Frankenberg, C., Gautam, R., Guanter, L., Kelley, J., McKeever, J., Ott, L. E., Poulter, B., Qu, Z., Thorpe, A. K., Worden, J. R., and Duren, R. M.:

Point source imagers, on the other hand, take much smaller photos that have much finer resolution, with pixel sizes down to just a few meters wide. That means they provide geographically limited data — they have to be programmed to aim their lenses at very specific targets. But within each image is much more actionable data.

For example, GHGSat, a private company based in Canada, operates a constellation of 12 point-source satellites, each one about the size of a microwave oven. Oil and gas companies and government agencies pay GHGSat to help them identify facilities that are leaking. Jean-Francois Gauthier, the director of business development at GHGSat, told me that each image taken by one of their satellites is 12 kilometers wide, but the resolution for each pixel is 25 meters. A snapshot of the Permian Basin, a major oil and gas producing region in Texas, might contain hundreds of oil and gas wells, owned by a multitude of companies, but GHGSat can tell them apart and assign responsibility.

“We’ll see five, 10, 15, 20 different sites emitting at the same time and you can differentiate between them,” said Gauthier. “You can see them very distinctly on the map and be able to say, alright, that’s an unlit flare, and you can tell which company it is, too.” Similarly, GHGSat can look at a sprawling petrochemical complex and identify the exact tank or pipe that has sprung a leak.

But between this extremely wide-angle lens, and the many finely-tuned instruments pointing at specific targets, there’s a gap. “It might seem like there’s a lot of instruments in space, but we don’t have the kind of coverage that we need yet, believe it or not,” Andrew Thorpe, a research technologist at NASA’s Jet Propulsion Laboratory told me. He has been working with the nonprofit Carbon Mapper on a new constellation of point source imagers, the first of which is supposed to launch later this year.

The reason why we don’t have enough coverage has to do with the size of the existing images, their resolution, and the amount of time it takes to get them. One of the challenges, Thorpe said, is that it’s very hard to get a continuous picture of any given leak. Oil and gas equipment can spring leaks at random. They can leak continuously or intermittently. If you’re just getting a snapshot every few weeks, you may not be able to tell how long a leak lasted, or you might miss a short but significant plume. Meanwhile, oil and gas fields are also changing on a weekly basis, Joost de Gouw, an atmospheric chemist at the University of Colorado, Boulder, told me. New wells are being drilled in new places — places those point-source imagers may not be looking at.

“There’s a lot of potential to miss emissions because we’re not looking,” he said. “If you combine that with clouds — clouds can obscure a lot of our observations — there are still going to be a lot of times when we’re not actually seeing the methane emissions.”

De Gouw hopes MethaneSAT will help resolve one of the big debates about methane leaks. Between the millions of sites that release small amounts of methane all the time, and the handful of sites that exhale massive plumes infrequently, which is worse? What fraction of the total do those bigger emitters represent?

Paul Palmer, a professor at the University of Edinburgh who studies the Earth’s atmospheric composition, is hopeful that it will help pull together a more comprehensive picture of what’s driving changes in the atmosphere. Around the turn of the century, methane levels pretty much leveled off, he said. But then, around 2007, they started to grow again, and have since accelerated. Scientists have reached different conclusions about why.

“There’s lots of controversy about what the big drivers are,” Palmer told me. Some think it’s related to oil and gas production increasing. Others — and he’s in this camp — think it’s related to warming wetlands. “Anything that helps us would be great.”

MethaneSAT sits somewhere between the global mappers and point source imagers. It will take larger images than GHGSat, each one 200 kilometers wide, which means it will be able to cover more ground in a single day. Those images will also contain finer detail about leaks than GOSAT, but they won’t necessarily be able to identify exactly which facilities the smaller leaks are coming from. Also, unlike with GHGSat, MethaneSAT’s data will be freely available to the public.