

OFFICE OF AIR QUALITY PLANNING AND STANDARDS RESEARCH TRIANGLE PARK, NC 27711

## 2/21/2025

Dr. Jason McKeever GHGSat, Inc. 1980 Post Oak Boulevard Suite 100 Houston, TX 77056

Dear Dr. McKeever:

We are writing in response to your submission on behalf of GHGSat, located in Houston, Texas, dated May 30, 2024, and subsequent correspondence dated September 06, 2024 and January 24, 2025, in which you request the approval of "Alternative Test Method for Methane Detection Technology" under the New Source Performance Standards for Crude Oil and Natural Gas Facilities for which construction, modification, or reconstruction commenced after December 6, 2022 (40 CFR Part 60, Subpart OOOOb). We are considering this request under 40 CFR <u>60.5398b(d)</u>, based on the information you have submitted (as described below). The EPA's Office of Air Quality Planning and Standards has been delegated certain authorities under this provision, including authority to consider and/or approve alternative test methods for methane detection technology.

As we understand, GHGSat has developed a measurement solution that uses infrared spectroscopy methane detection technology affixed to a manned aircraft to identify and localize methane emissions emanating from equipment or other surfaces on the ground.

To support your submittal, you have provided the following documents associated with your submission, either submitted through EPA's public facing portal or through EPA's Confidential Business Information (CBI) Office with a CBI claim:

Alternative Test Method Application Executive Summary received on May 30, 2024, and updated September 06, 2024, and January 24, 2025, which provides submission information, technical summary of the technology, summary of documents submitted and additional contextualizing information. See <u>§60.5398b(d)(2)</u> and <u>§60.5398b(d)(3)(i)-(ii)</u>.

- Description of Technology, received on May 30, 2024, and updated September 06, 2024, and January 24, 2025, that details the relevant measurement technology including measurement theory, instrumentation, application, and known limitations. See <u>§60.5398b(d)(3)(iii)-(v)</u> and <u>§60.5398b(d)(3)(vi)(B) & D</u>.
- Description of Technology Visual Workflow, received on May 30, 2024, and updated September 06, 2024, that details the data pipeline workflow for the technology. See 60.5398b(d)(3)(iv)(A).
- Peer reviewed research articles received on May 30, 2024, as supporting evidence that this aerial measurement technology can appropriately identify and localize methane emissions at the 15 kg/hr threshold, as applied in the field. See §60.5398b(d)(3)(vi).
  - Varon, D J, Jacon, D J, McKeever, J, Jervis, D, Durak, B O A, Xia, Y, Huang, Y. 2018. Quantifying methane point sources from fine-scale satellite observations of atmospheric methane plumes. Atmospheric Measurement Techniques 11(10). DOI: <u>https://doi.org/10.5194/amt-11-5673-2018</u>. Peer-reviewed research article documenting plume quantification methods for use on remotely detected finescale methane plumes.
  - Jervis, D, Mckeever, J, Durak, B O A, Sloan, J J, Gains, D, Varon, D J, Ramier, A, Strupler, M, Tarrant, E. 2021. The GHGSat-D imaging spectrometer. Atmospheric Measurement Techniques 14(3). DOI: <u>https://doi.org/10.5194/amt-14-2127-2021</u>. Peer-revied research article summarizing the spectrometer design.
  - El Abbadi, S H, Chen, Z, Burdeau, P M, Rutherford, J S, Chen, Y, Zhang, Z, Sherwin, E D, Brandt, A R. 2024. Technological Maturity of Aircraft-Based Methane Sensing for Greenhouse Gas Mitigation. Environmental Science & Technology 53(22). DOI: <u>https://doi.org/10.1021/acs.est.4c02439</u>. Peer-reviewed research article summarizing the performance of airborne methane sensing technology on manned aircraft platforms, using a single blinded assessment model.
  - Mckeever, J, Jervis, D. Validation and Metrics for Emissions Detection by Satellite. White Paper. September 2022. White paper documenting considerations and constraints on the detection limit for satellite measurements, specifically focusing on sensitivity, specificity, and quantification accuracy.
- A sampling protocol titled "GHGSat DATA.AIR Gen 1 Formal Alternative Test Method." Final version received January 24, 2025, including all the required procedures and applicable quality assurance and control, consistent with your operation of the solution, which provides the company's qualifications that meets the requirements in §60.5398b(d)(2)(i) through §60.5398b(d)(2)(iv), and all information required for an alternative test method application according to §60.5398b(d)(3).

EPA conducted an initial review of the submitted material, based on this review and receipt of additional information and consistent with the requirements in §60.5398b(d)(1)(i), EPA determined your submission to be complete.

Based on a review of the provided material and a recognition that GHGSat meets the criteria found in  $\frac{60.5398b(d)(2)}{50.5398b(d)(2)}$ , we have determined that the GHGSat DATA.AIR Gen 1 detection technology meets the periodic screening requirements for technologies with a detection sensitivity of 15 kg/hr at 90% probability of detection using the protocol described above. Additionally, we are approving your solution and the associated protocol (MATM-007) for use by an owner or operator of an affected facility provided the following caveats are met in the alternative periodic screening process as described in  $\frac{60.5398b(b)}{50.5398b(b)}$ .

Furthermore, GHGSat DATA.AIR Gen 1 Technology may be used as an alternative to fugitive emissions monitoring under the New Source Performance Standards for Crude Oil and Natural Gas Facilities for which construction, modification or reconstruction commenced after September 18, 2015, and on or before December 6, 2022 (40 CFR Part 60, Subpart OOOOa) provided the owner or operator using the solution complies with <u>\$60.5398b</u>, including the notification, recordkeeping, and reporting requirements outlined in <u>\$60.5424b</u>.

Because the alternative method may be used by owners and operators subject to the monitoring of fugitive emissions components affected facilities, and inspection and monitoring of covers and closed vent systems subject to 40 CFR part 60, Subparts OOOOa and OOOOb, we will post this letter as **MATM-007** on the EPA website at <u>https://www.epa.gov/emc/oil-and-gas-alternative-test-methods</u> for use by interested parties.

This approval letter is not an implied or express endorsement by EPA of any specific companies or products, as EPA does not promote the products, services, or enterprises of non-federal entities. This letter may be freely distributed and used for non-commercial, scientific and educational purposes. The use of the official EPA Seal and Logo is intended for US Government purposes only and may only be reproduced and used with the express, written permission of EPA's Office of Public Affairs. Further, the EPA Seal or Logo may not be used in a way that implies an EPA endorsement. If you should have any questions or require further information regarding this approval, please contact my staff at <u>MethaneATM@epa.gov</u>.

Sincerely,

Steffan M. Johnson, Group Leader Measurement Technology Group

cc: Greg Fried, OECA/AED Elizabeth Leturgey, OECA/OC Ned Shappley, OAQPS/AQAD Karen Wesson, OAQPS/AQAD Regional Testing Contacts

Attachments (2)

GHGSat - Aerial Survey Alternative Test Method (MATM-007).pdf

Memo to the Docket, Acceptance Justification: GHGSat Airborne DATA.AIR Gen 1 Methane Alternative Technology

## MEMORANDUM

TO: EPA-HQ-OAR-2024-0619

FROM: Hannah Halliday, EPA

DATE: February 21, 2025

## Subject: Acceptance Justification: GHGSat Airborne DATA.AIR Gen 1 Methane Alternative Technology

This Memorandum summarizes EPA's consideration of the technical basis for GHGSat's methane emissions detection and quantification technology documented in ALTTECH-21 (15 hg/hr). This application was initially submitted on May 30, 2024, as part of the Advanced Methane Detection Alternative Test Methods Program (40 CFR 60.5398b(d)). The final submission of documents occurred on January 24, 2025. The documents contained in the final application were used to develop the final alternative test method, MATM-007. EPA's consideration of this technology under this program and its application to the Advanced Methane Detection Alternative Test Method program is further described in EPA's approval letter dated February 21, 2025. This Memorandum also includes a summary of the meetings between GHGSat and EPA staff related to GHGSat's request for approval of this technology.

GHGSat's aerial survey technology documented in ALTTECH-21 uses an infrared spectrometer mounted in a fixed wing aircraft to image and quantify methane plumes during planned surveys of their client's assets. Spectrometry imagery from transects of the client site is combined with meteorological data, ground asset data, and contextualizing data from the aircraft to quantify emissions at facility-level resolution during periodic airborne surveys of applicable oil and gas facilities. GHGSat provided comprehensive details on how this technology works and how it's applied through the Description of Technology document, consistent with 40 CFR 60.5398b(d)(3)(iii), 40 CFR 60.5398b(d)(3)(iv), and 40 CFR 60.5398b(d)(3)(v). The Description of Technology document was submitted via the public-facing portal. GHGSat submitted Additional technical procedures and details claimed as Confidential Business Information (CBI). Additionally, GHGSat provided supporting documentation outlining how this technology is applied to leak detection and quantification in the field, including end-user documentation which were claimed as CBI. GHGSat also submitted peer-reviewed journal articles and white papers through the public facing portal, as discussed in 40 CFR 60.5398b(d)(3)(vi).

GHGSat technology uses shortwave infrared (SWIR) reflected sunlight to detect enhancements of methane and calculate emission rates of identified leak locations over their client sites. Absorbance bands in the infrared spectra are used to detect methane in the air column beneath the detector, using a

spectrometer that utilizes the motion of the aircraft to scan a target spectroscopy window to detect methane. The spectrometer data is combined with aircraft data, modeled meteorology data, and contextualizing information including topography and asset information. Raw observations are processed with a proprietary data pipeline under analyst supervision, using subsidiary methods that have been well established in the scientific literature. This method results in detection first reporting, where all confirmed detected plumes associated with client assets are quantified and reported.

The 90% Probability of Detection for MATM-007, as determined through a blinded controlled release study conducted by Stanford University (Abbadi et.al 2024)<sup>1</sup>, was determined to be 13.4 kg/hr. GHGSat has put in place robust quality assurance checks, and clearly documented their collection protocol and associated data quality indicators (DQIs) for determining valid emissions. Surveys must be undertaken under a prescribed environmental envelope of operation which has been validated with controlled release studies, and the analysis is supervised by trained analysts that account for confounding environmental and measurement factors.

The primary limitations of this technology are inherent to any spectroscopy method that relies on reflected sunlight. The method (MATM-007) sufficiently identifies this limitation and requires that measurements must be collected during daylight hours, under clear conditions, within a defined meteorological and surface regime. Diffuse plumes with low enhancements over the atmospheric methane background are not well characterized with this method, and quantification uncertainties are largely driven by windspeed uncertainties. Finally, this method is specific to the current implementation of their proprietary pipeline; small parameter changes in their retrieval methods, coupled with changes to the meteorological sourcing, could lead to differences in both the plume detection and plume quantification from the same underlying radiance data.

GHGSat's request for an alternative test method for methane detection technology was submitted and reviewed per the requirements in 40 CFR 60.5398b(d)(1). Based on the submitted materials, GHGSat meets the requirements for a submitting entity, per 40 CFR 60.5398b(d)(2). GHGSat's request includes all the information required per 40 CFR 60.5398b(d)(3).

<sup>&</sup>lt;sup>1</sup> El Abbadi, S H, Chen, Z, Burdeau, P M, Rutherford, J S, Chen, Y, Zhang, Z, Sherwin, E D, Brandt, A R. 2024. Technological Maturity of Aircraft-Based Methane Sensing for Greenhouse Gas Mitigation. Environmental Science & Technology 53(22). DOI: https://doi.org/10.1021/acs.est.4c02439. Peer-reviewed research article summarizing the performance of airborne methane sensing technology on manned aircraft platforms, using a single blinded assessment model.

Date	Venue	Participants	Topics
2024-02-12	Teams Call	Ned Shappely, Dylan	Answering general questions about the OOOOb/c
		Jervis, Jason	rules and implementation, on both Super Emitter
		McKeever, Dave	Program and Alt-Tech program.
		Nash, Paul Van Rooy,	
		Luke Valin, Aaron	
		Margolis, Todd	
		Webster, Eric Choi,	
		Stanley Opara, Ryan	
		Mattson, Mike Cuzzi,	
		Hannah Halliday	
2024-05-13	Teams Call	Stanley Opara,	Pre-application conversation, covering requirements
		Antopine Ramier, Eric	on the description of technology document, going
		Choi, Marianne	over general requirements, and discussing the
		Girard, Ned	documentation needed on any Artifical Intelligence
		Shappley, Paul Van	(AI) components in the technology.
		Rooy, Dave Nash,	
		Hannah Halliday,	
		Michael Stovern	
2024-07-25	Teams Call	Antoine Ramier,	Application review between GHGsat and Review
		Jason McKeever,	Team; Clarifying some questions from the review
		Stanley Opara,	team and providing feedback on the application.
		Hannah Halliday,	
		Walter Lin, Carlos	
		Valle Diaz	
2024-11-20	Teams Call	Ned Shappley,	Feedback on potential revisions, and an addon
		Stanley Opara, Jason	discussion with the EPA AI team to discuss rights
		McKeever, Niki	and safety.
		Maslin, Richard Allen,	
		Aaron Margolis, Jane	
		Wallace, Jason	
		McKeever, Antoine	
		Ramier, Walter Lin,	
		Hannah Halliday	
2024-12-11	In-Person	Jason McKeever,	At the American Geophysical Union Conference
		Hannah Halliday,	(AGU) Fall Meeting, going over some feedback and
		Antoine Ramier	edits on the formal method
2024-12-19	Zoom	Antoine Ramier,	Reviewing edits to the Formal method and feedback
	Meeting	Jason McKeever,	& Questions on the application status
		Stanley Opara,	
		Walter Lin, Hannah	
		Halliday	
2024-01-23	Phone Call	Antoine Ramier,	Next steps and finalizing phone call
		Hannah Halliday	

## Meeting Summary between EPA Measurement Technology Group and GHGSat