Example: Email to Operators

From: CARB Methane Plume Detection

To: [redacted]

Subject: Methane Plume Detection; Follow-up Requested

Date: Tuesday, November 16, 2021 1:32:51 PM

Attachments: GAO20211112t182702p0000-A_r587_c334_ctr.tif
GAO20211112t182702p0000-A_r587_c334_rgb.tif
O&G Operator Feedback Form.docx

Dear [redacted],

This is a notification that a plume of methane has been detected by an aircraft at a piece of infrastructure belonging to your company. This detection was made on the date indicated below by a hyperspectral imager developed by NASA's Jet Propulsion Laboratory. This is not a citation or enforcement action, but rather, part of a research effort in preparation for future satellite capabilities that will detect methane plumes and produce this type of data continuously. Additional information about this research project is provided at the end of this email. We ask that you verify the source of the plume as requested below and notify us of your findings. At this time we are only notifying you. Within one week, the information below, including any feedback you have shared with us about steps to mitigate the plume will be shared with your local air district. As part of our research efforts, information about the plume will later be made public on a web portal (https://msf.carb.arb.ca.gov).

Date, time, and location of the detected plume:

Candidate ID	Plume Latitude (deg)	Plume Longitude (deg)	Date	Time (Pacific)
GAO20211112t182702p0000-A_r587_c334	[redacted]	[redacted]	2021/11/12	10:27:02

What are we asking you to do? We ask that you carefully inspect the attached imagery and verify that this piece of infrastructure belongs to you. If it does not belong to you but you know the owner, please let us know. If you are the owner of the infrastructure in question, we ask that you conduct measurements on the ground to verify that there is a methane leak at the indicated infrastructure. Note that the coordinates above are an approximate location of the leak and should not be treated as a precise location. If the leak can be fixed, please do so. Finally, please fill out the attached feedback form and return it to us within 1-2 weeks.

A number of attachments are provided with this email. These include:

- Static plume images (.jpg files, embedded the email body). These non-interactive images show the detected plume overlaid on a satellite map of the area, with multiple zoom levels. Note that the background image may not be up-to-date and may not reflect recent land use changes.
- GeoTiffs (.tif files). This includes a methane plume GeoTiff and a background image GeoTiff captured by the airborne sensor. While not necessary, you may wish to import these files into a GIS platform of your choice, such as Google Earth or ArcGIS, to interactively view the plume images.
- A feedback form. After inspecting your equipment and repairing the leak (if possible), We request that you fill out this form and send it back to us in a timely manner.

Additional information about this research project:

CARB has used remote sensing technology to detect individual methane plumes coming from various industrial sectors in California, including oil and gas, waste management, and agriculture since 2016. CEC/NASA/CARB sponsored JPL to survey most of the state in several campaigns, during a study we refer to as the California Methane Survey, and found that a significant fraction of total methane emissions are emitted in plumes that can be identified with this remote sensing technique. A follow-up study showed that more than half of the leaks detected with this technology could be quickly repaired. Flights in 2021 were funded by philanthropists through the non-profit Carbon Mapper (https://carbonmapper.org/). This type of remote sensing technology holds promise to work well within our existing regulations, to provide more regular information on leaks in our infrastructure and allow for additional emission reduction. To that end California and several partners are planning to launch satellites starting in 2023 to provide this type of data regularly.

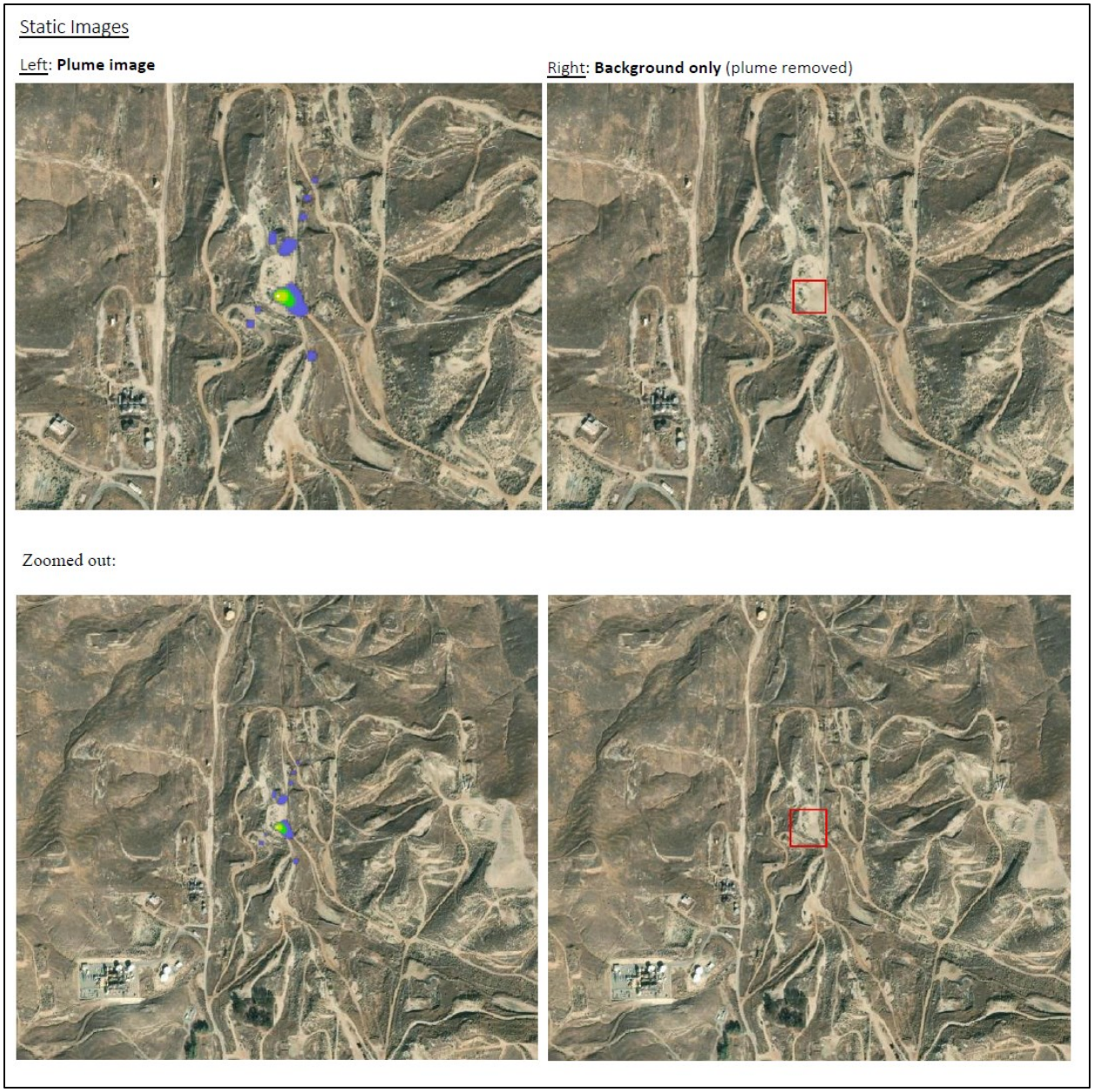

Figure A1. An example of the standard email sent to operators where plumes were detected.

Example: Operator Feedback Form

CARB Methane Satellite Dry Run – Industry Follow-up

Fill out this form for each notification from CARB of a plume identified from the plane. Complete all fields if possible. *Items in italics are optional but preferred.*

Note: For components subject to CARB's Oil and Gas Methane Regulation,[1] leaks measured by the operator at or above 1,000 ppm using US EPA Method 21 must be repaired according to the timeframes in the regulation and must be reported to CARB as part of operators' annual LDAR reports. Per the regulation, all leaks detected with the use of an optical gas imaging (OGI) instrument must be measured using Method 21 within two calendar days of initial OGI leak detection.

Operator	
Contact information	
Plume ID (provided by CARB)	
Lat/Lon coordinates (provided by CARB)	
Date of on the ground follow-up	
Instrument used to locate the leak (e.g., OGI camera, Method 21 instrument)	
Was an emission source identified?	
What type of facility[2] were the emissions coming from?	
What type of equipment[3] were the emissions coming from?	
What type of component[4] were the emissions coming from (if applicable)?	
Was the source of emissions a leak (unintentional) or a vent (intentional)?	
Instrument used to measure concentration of the leak (Method 21 type instrument)	
Concentration of the leak	ppm

[1] California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4. Subarticle 13: Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities.
[2] Examples of possible facility types: oil or gas production facility, gathering and boosting station, transmission compressor station, natural gas processing plant, natural gas storage facility.
[3] Examples of possible equipment types: tank, pressure separator, sump, pond, reciprocating natural gas compressor, centrifugal natural gas compressor, continuous high bleed pneumatic device, continuous low bleed pneumatic device, intermittent bleed pneumatic device, pneumatic pump, open well casing vent.
[4] Examples of possible component types: connector, valve, flange, open-ended line.

Mitigation actions taken (if it was a leak)	
Date of mitigation actions	
Additional Comments	

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Figure A2. The two-page operator feedback form sent to operators for each leak detection.

Complete Incidence List from 2021

Table A1. List of all incidences that were sent to operators in 2021 (note: notification, inspection, and reply dates were not logged in 2020 and are not included here).

Incidence ID	Earliest Plume Measurement	Number of Plumes in Incidence	Sector	Incidence Emission Type	Incidence Notification Date	Incidence Inspection Date	Incidence Mitigation Date	Incidence Reply Date
1	11/5/2021	4	Oil & Gas	Process	11/16/2021	11/17/2021		11/29/2021
4	11/5/2021	1	Oil & Gas	Not Found	11/12/2021	11/16/2021		11/19/2021

5	11/5/2021	2	Oil & Gas	Unintentional - Stopped or Repaired	11/8/2021	11/9/2021	11/9/2021	11/9/2021
6	11/5/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/16/2021	11/18/2021	11/19/2021
8	11/5/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/8/2021	11/9/2021	11/15/2021	11/17/2021
9	11/5/2021	2	Oil & Gas	Unintentional - Stopped or Repaired	11/8/2021	11/9/2021	11/9/2021	11/16/2021
10	11/5/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/10/2021	11/10/2021	11/10/2021	11/16/2021
11	11/5/2021	3	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/12/2021		12/17/2021
12	11/5/2021	3	Oil & Gas	Temporary	11/12/2021	11/10/2021		11/16/2021
13	11/5/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/10/2021	11/10/2021	11/10/2021	11/10/2021
14	11/5/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/10/2021	11/11/2021	11/16/2021	11/16/2021
15	11/6/2021	2	Oil & Gas	Unintentional - Stopped or Repaired	11/8/2021	11/9/2021	11/10/2021	11/16/2021
16	11/7/2021	1	Landfills	Temporary	11/12/2021	12/1/2021	12/1/2021	12/1/2021
17	11/7/2021	1	Landfills	Process	11/12/2021			12/7/2021
18	11/7/2021	1	Landfills	Unintentional - Stopped or Repaired	11/12/2021	11/12/2021	11/19/2021	6/16/2022
19	11/7/2021	1	Landfills	Temporary	11/12/2021			12/7/2021

22	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/18/2021	11/25/2021	11/25/2021
23	11/8/2021	2	Oil & Gas	Temporary	11/12/2021	11/17/2021	11/18/2021	11/19/2021
24	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/15/2021	12/8/2021	12/17/2021
25	11/8/2021	1	Oil & Gas	Not Found	11/12/2021	11/15/2021		11/17/2021
26	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/12/2021	11/12/2021	11/19/2021
28	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/15/2021	11/15/2021	11/15/2021
29	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/15/2021	11/15/2021	11/19/2021
30	11/8/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/12/2021	11/15/2021	11/15/2021	11/19/2021
32	11/8/2021	1	Oil & Gas	Temporary	12/17/2021			12/23/2021
35	11/10/2021	2	Landfills	Did not Respond	11/16/2021			
36	11/10/2021	2	Landfills	Temporary	11/16/2021			12/7/2021
37	11/10/2021	1	Landfills	Unintentional - Stopped or Repaired	11/16/2021	12/1/2021	12/1/2021	3/1/2022
38	11/10/2021	2	Landfills	Unintentional - Stopped or Repaired	11/16/2021	11/22/2021	11/22/2021	3/1/2022
39	11/10/2021	3	Landfills	Unintentional - Stopped or Repaired	11/16/2021	11/22/2021	11/22/2021	3/1/2022

40	11/10/2021	2	Landfills	Not Found	11/16/2021			7/1/2022
41	11/10/2021	2	Landfills	Process	11/16/2021	11/11/2021		7/1/2022
42	11/10/2021	1	Oil & Gas	Did not Respond	11/17/2021			
43	11/12/2021	2	Oil & Gas	Process	11/16/2021	12/2/2021		12/14/2021
44	11/12/2021	1	Oil & Gas	Process	11/16/2021	11/18/2021		12/2/2021
45	11/12/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/16/2021	11/16/2021	11/18/2021	12/2/2021
46	11/12/2021	1	Oil & Gas	Temporary	11/16/2021			12/3/2021
47	11/12/2021	2	Oil & Gas	Temporary	11/16/2021	11/12/2021		12/14/2021
48	11/12/2021	2	Oil & Gas	Temporary	11/16/2021	11/12/2021		12/14/2021
50	11/12/2021	1	Oil & Gas	Temporary	11/16/2021	11/17/2021		11/19/2021
69	11/12/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/16/2021	12/6/2021	12/6/2021	12/8/2021
70	11/12/2021	1	Oil & Gas	Not Found	11/16/2021	11/17/2021		12/6/2021
72	11/12/2021	1	Oil & Gas	Process	11/16/2021	11/17/2021		12/17/2021
73	11/12/2021	2	Oil & Gas	Process	11/16/2021			12/10/2021
74	11/12/2021	1	Oil & Gas	Not Found	11/16/2021	11/17/2021		11/19/2021
75	11/12/2021	2	Oil & Gas	Temporary	11/16/2021	11/18/2021	11/18/2021	11/19/2021

77	11/13/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/16/2021	11/17/2021	11/22/2021	11/30/2021
78	11/13/2021	1	Oil & Gas	Not Found	11/16/2021	11/17/2021		12/1/2021
80	11/13/2021	1	Oil & Gas	Temporary	11/16/2021	11/17/2021		11/24/2021
81	11/13/2021	1	Oil & Gas	Unintentional - Stopped or Repaired	11/16/2021	11/17/2021	11/17/2021	11/24/2021
82	11/13/2021	1	Oil & Gas	Temporary	11/16/2021	11/17/2021		11/24/2021
83	11/11/2021	1	Landfills	Did not Respond	11/16/2021			
85	11/11/2021	1	Landfills	Unintentional - Stopped or Repaired	11/16/2021	11/17/2021	11/18/2021	11/22/2021
87	11/11/2021	1	Landfills	Unintentional - Stopped or Repaired	11/16/2021	11/22/2021	11/22/2021	3/1/2022
88	11/11/2021	1	Landfills	Unintentional - Stopped or Repaired	11/16/2021	11/22/2021	11/22/2021	3/1/2022