Remote Sensing and Monitoring of Methane Emissions from Landfills

Ángel E. Esparza, PhD, P.E., CESCO and Brody Wight, Director
GHGSat Inc.

Introduction

The generation of waste is a byproduct of living things.
Municipal Solid Waste (MSW) is primarily generated by human activity.

Waste: Any garbage, refuse, sludge from a wastewater treatment plant, or air pollution control facility, and other discarded material, including soil, liquid, semisolid, or contained gaseous material, resulting from industrial, commercial, mining, and agricultural operations and from community activities.

Objective

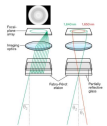
Describe unique advantages of using the same sensor in space and airborne for remotely detecting methane emissions generated by landfills.

Remote Sensing of Methane

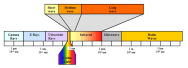
- Methane is generated from the anaerobic degradation of organic wastes within landfills.
- Methane is a short-lived (8-12 years) climate pollutant.
- Global warming potential (GWP) of 84-87 over a 20-year timeframe.

Technology

Sensor



Fabry-Perot
Spectrometer



Shortwave Infrared

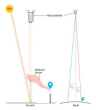
1,600-1,700 nm for methane

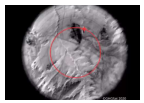
Satellite Platform

Microsatellite
Polar Orbiting
15 Orbits/day

Sun-synchronous
500 km in Altitude

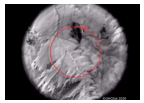
200 captures
200,000 pixels/ image





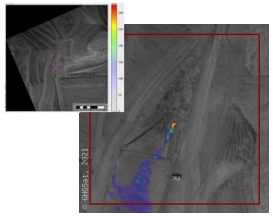
~ 12 km x 12 km Field of View
~25-30 meter in Spatial Resolution
100 kg/hr detection threshold

Airborne Variant Platform

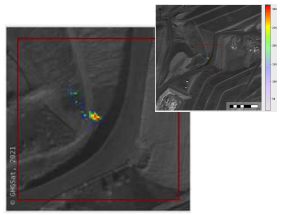


~ 750 m Swath width
<1 meter in Spatial Resolution
10 kg/hr detection threshold

2021 Southwestern USA Aircraft Campaign



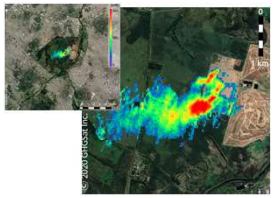
$\dot{m}$= 20 kg/hr



$\dot{m}$= 51 kg/hr

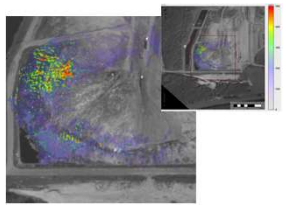
Detecting Landfill Methane with Two Platforms

Satellite Platform



$\dot{m}$= 8,800 kg/hr
South America

Airborne Variant Platform



$\dot{m}$= 500 kg/hr
Central USA

Conclusion

- The ability to use the same sensor in space and airborne can provide unique advantages in supporting the waste management industry with frequent, accurate, and affordable monitoring of methane.
- The results presented demonstrate the feasibility and effectiveness of using the same sensor at different altitudes.
- The addition of satellites to the existing constellation will increase the frequency of measurements, shortening the time between measurement opportunities.
- GHGSat plans to add 3 satellites in June 2022, and 5 more in 2023, to a total constellation of 10 satellites dedicated to methane detection.

References

- Varon, D.J., McKeever, J., Jervis, D., Maaskkers, J.D., Pandey, S., Houwelling, S., Aben, I., Scarpelli, T., Jacob, D. J.: Satellite discovery of anomalously large methane point sources from oil/gas production, Geophysical Research Letters, 10.1029/2019GL083798, 2019.
- Varon, D.J., Jervis, D., McKeever, J., Spence, I., Gains, G., Jacob, D. J.,: High-frequency monitoring of anomalous methane point sources with multispectral Sentinel-2 satellite observations, Atmos. Meas. Tech., 14, 2771-2785, 2021.
- Jervis, D., McKeever, J., Durak, B. O. A., Sloan, J. J., Gains, D., Varon, D. J., Ramier, A., Strupler, M., and Tarrant, E.: The GHGSat-D imaging spectrometer, Atmos. Meas. Tech., 14, 2127-2140, 2021.
- Varon, D.J., Jacob, D. J., Jervis, D., and McKeever, J.: Quantifying time-averaged methane emissions from individual coal mine vents with GHGSat-D satellite observations, Environ. Sci. Technol., 54, 16, 10246–10253, 2020.
- Ramier, A.; Deglint, H.; Gains, D.; Jervis, D.; McKeever, J.; Shaw, W.; Strupler, M.; Tarrant, E.; Varon, D. J.; GHGSat-C1 – 510 Initial Results, Design, and Characterization, Abstract (A247-03) presented at AGU 2020 Fall Meeting, 1-17 December 2020.
- Varon, D. J., Jacob, D. J., McKeever, J., Jervis, D., Durak, B. O. A., Xia, Y., and Huang, Y.: Quantifying methane point sources from fine-scale satellite observations of atmospheric methane plumes, Atmos. Meas. Tech., 11, 5673–5686, 2018.
- Jacob, D. J., Turner, A. J., Maasakkers, J. D., Sheng, J., Sun, K., Liu, X., Chance, K., Aben, I., McKeever, J., and Frankenberg, C.: Satellite observations of atmospheric methane and their value for quantifying methane emissions, Atmos. Chem. Phys., 16, 14371–14396, 2016.
- Esparza, Ángel E., and Jean-François Gauthier. 2021. "Monitoring leaks at oil and gas facilities using the same sensor on aircraft and satellite platforms." SPE/AAPG/SEG Unconventional Resources Technology Conference. Houston. doi: https://doi.org/10.15530/urtec-2021-5666.
- Esparza, Ángel E., Mattson, Ryan, and Gauthier, Jean-François. 2021. "Monitoring leaks at oil and gas facilities using satellites in support of ESG initiatives. " ROGTEC Magazine, Issue 66. 02-Issue-66.pdf (rogtecmagazine.com)