GeoKinsella
Satellite Methane Detection & Quantification

Satellite methane screening at Montemarta-Cónica Landfill

Technical report for public interest review

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Executive summary

This investigation used observations from NASA EMIT, DLR EnMAP and Copernicus Sentinel-5P to test whether methane emissions from Montemarta-Cónica Landfill could be detected from space over the period January 2024 to October 2026, and to estimate their size where the data allow. NASA EMIT and DLR EnMAP provided 13 usable satellite observations of Montemarta-Cónica Landfill, with methane emissions detected on four of those 13 occasions. These repeated detections provide strong evidence of recurring methane emissions from the facility. Independently, the Sentinel-5P regional composite of 584 contributing observations shows a regional methane enhancement. Estimated emission rates range from 1.85 t/h to 3.17 t/h.

Methane is a potent greenhouse gas and the principal component of natural gas, so these emissions matter for the climate and represent a potentially recoverable energy resource.

The recommended response is to compare the detection dates with operational records, review the landfill-gas collection and recovery system and continue satellite monitoring.

Site and location

Montemarta-Cónica Landfill is located at 37.22360° N, 5.88101° W. The investigation covers 1 January 2024 to 31 October 2026. Figure 1 shows the location of Montemarta-Cónica Landfill within the surrounding region and the mapped facility boundary.

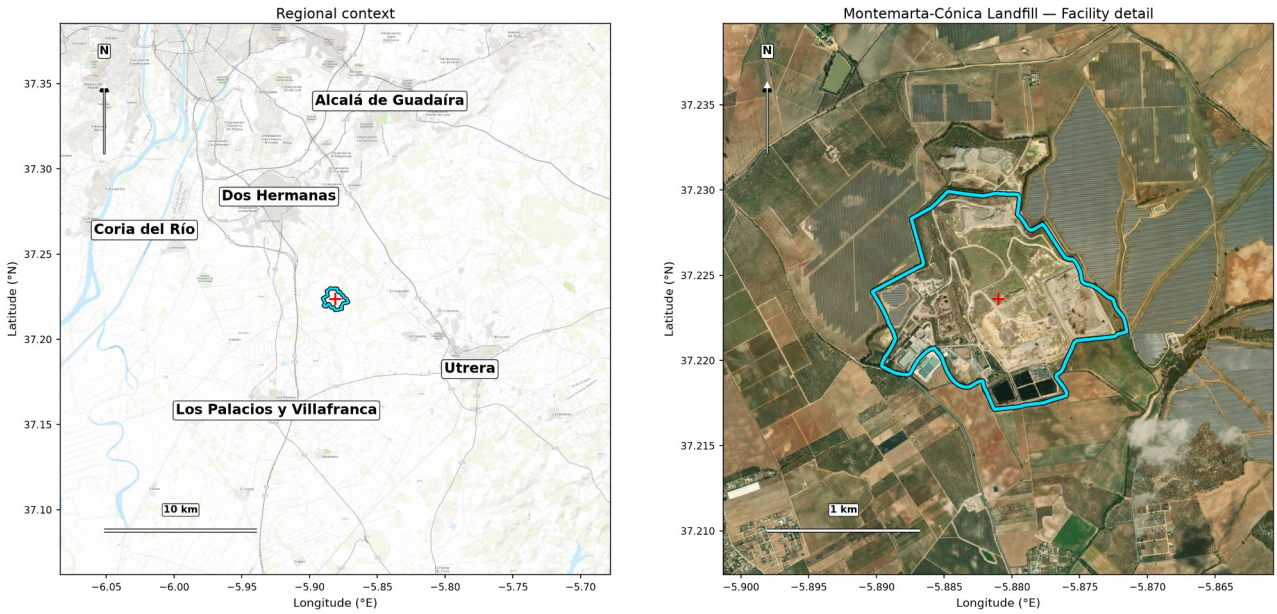


Figure 1. Regional geographic context (left) and detailed aerial view of Montemarta-Cónica Landfill (right). The facility boundary is outlined.

Scientific evidence base

EMIT and EnMAP observations identify methane enhancements on four dates associated with the landfill. Table 1 summarises the satellite evidence, including the 584-observation Sentinel-5P regional analysis.

Table 1. Satellite instruments, observation records and their contributions to the Montemarta-Cónica Landfill investigation.

System	Evidence used	What it contributes
NASA EMIT	9 observations	NASA imaging spectrometer observations at approximately 60 m pixel size.
DLR EnMAP	4 observations	DLR imaging spectrometer retrievals at approximately 30 m resolution.
Sentinel-5P	584 observations	A wind-rotated multi-pass record testing persistent regional site alignment.

NASA EMIT methane observations

NASA EMIT recorded methane enhancements associated with Montemarta-Cónica Landfill on 31 May 2025 and 22 June 2025. Figure 2 shows the methane patterns seen from space on the selected dates. Table 2 gives the result for each examined observation, including estimated emission rates where methane was detected.

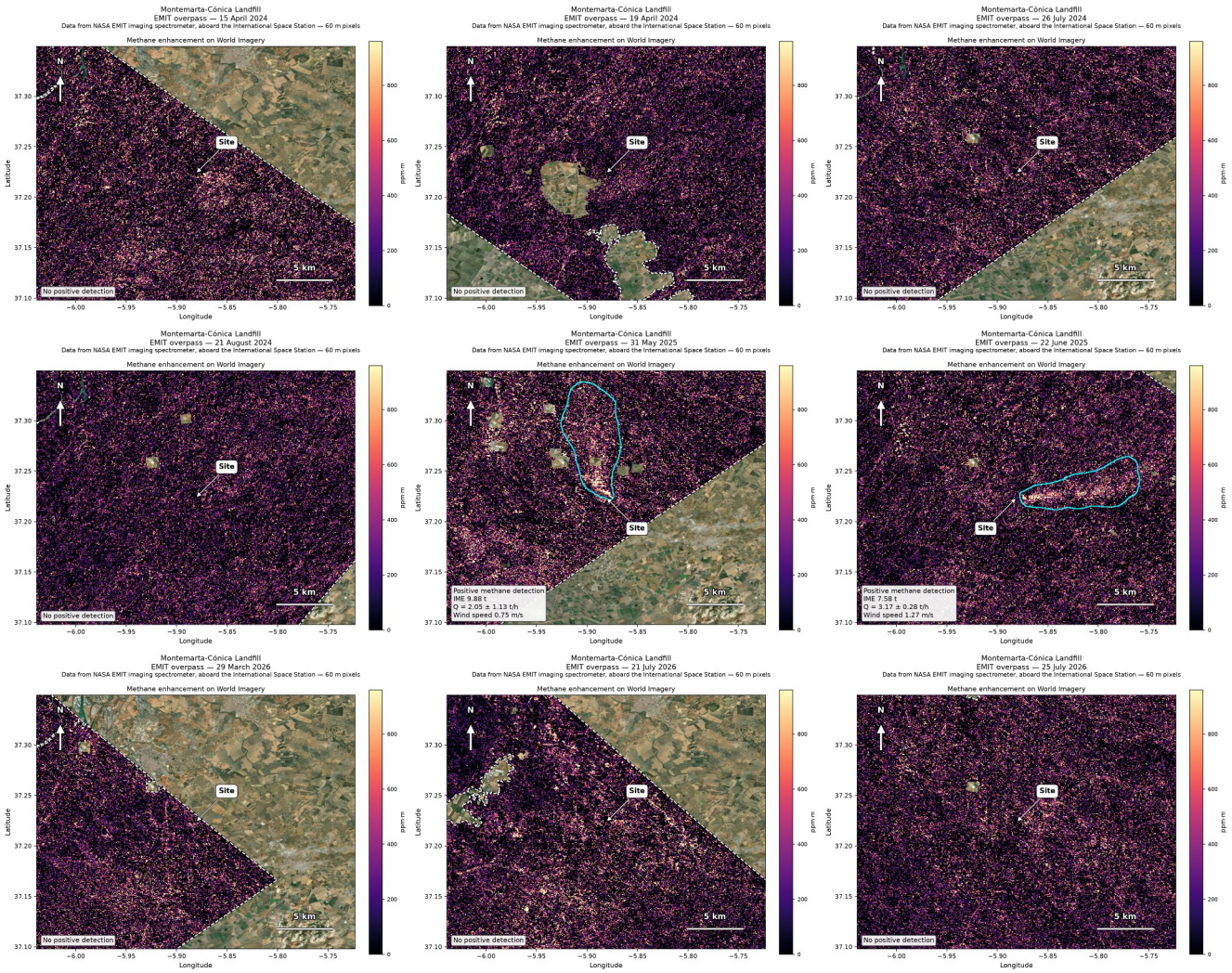


Figure 2. NASA EMIT methane observations at Montemarta-Cónica Landfill. Nine dated scenes show two positive methane detections and seven scenes without a positive detection.

Table 2. NASA EMIT observations and emission-rate estimates (Q ± σ).

Observation time (UTC)	Methane finding	Q ± σ (kg/h)	Q ± σ (t/h)
15 April 2024 14:05:34	No positive detection	—	—
19 April 2024 12:27:36	No positive detection	—	—
26 July 2024 14:33:26	No positive detection	—	—
21 August 2024 11:22:55	No positive detection	—	—
31 May 2025 12:14:21	Detected	2048 ± 1129	2.05 ± 1.13
22 June 2025 10:38:57	Detected	3168 ± 277	3.17 ± 0.28
29 March 2026 12:41:33	No positive detection	—	—
21 July 2026 15:30:21	No positive detection	—	—
25 July 2026 13:57:01	No positive detection	—	—

The two detected releases were estimated at 2,048 ± 1,129 and 3,168 ± 277 kg CH_4/h (2.05 ± 1.13 and 3.17 ± 0.28 t/h; Table 2). No observed detection does not mean that the site produced zero emissions. One of the lowest recorded detections using EMIT was by Thorpe et al. (2023), who documented methane emissions detected by EMIT as low as approximately 300 kg CH_4/h, and this should be regarded as the lowest limit in ideal conditions. EMIT Scout RECORD files flag Simple IME as wind-limited when reanalysis 10 m wind is below 2 m/s (31 May 2025 and 22 June 2025). That quality flag is retained in the results package and does not change the tabulated emission estimates.

DLR EnMAP methane observations

DLR EnMAP recorded methane enhancements associated with Montemarta-Cónica Landfill on 26 July 2025 and 3 September 2025. Figure 3 shows the methane patterns seen from space on the selected dates. Table 3 gives the result for each examined observation, including estimated emission rates where methane was detected.

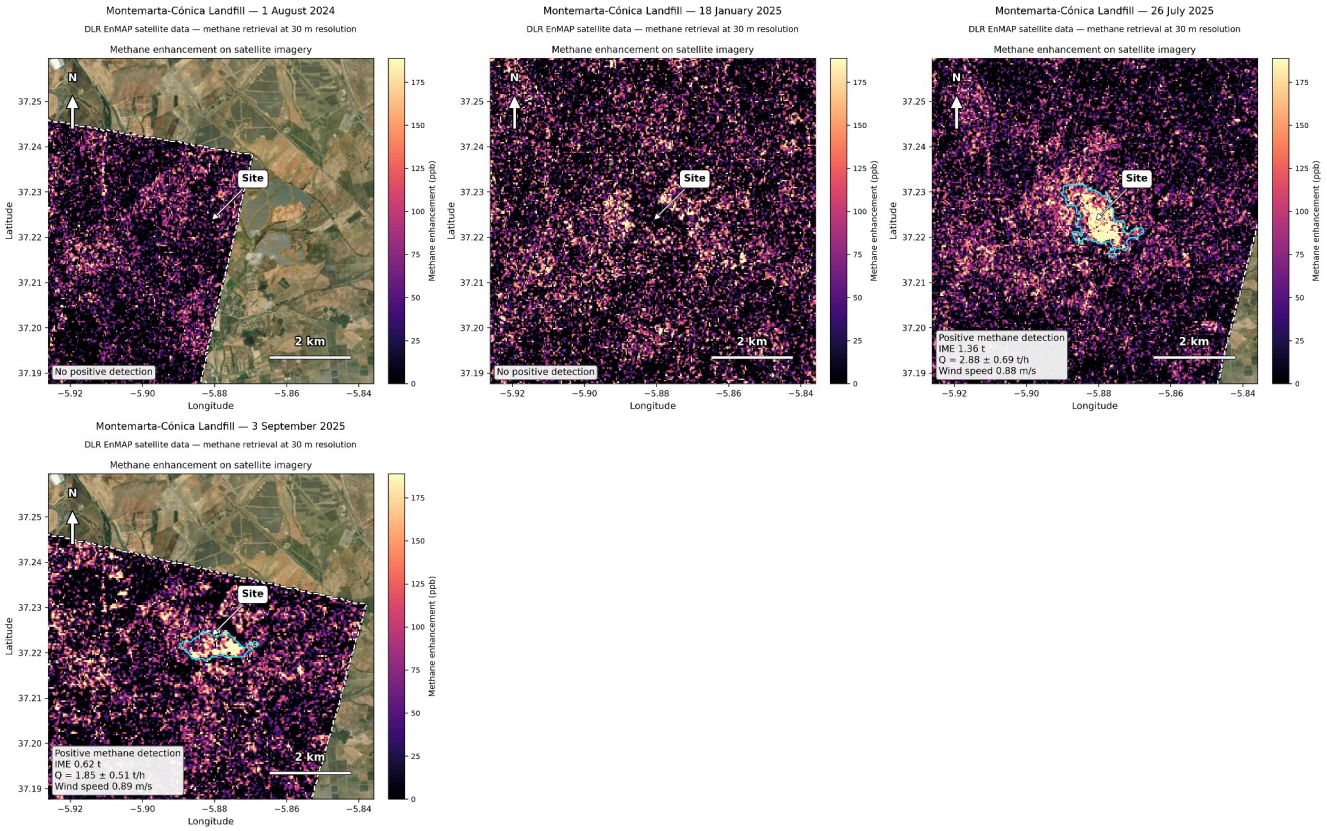


Figure 3. DLR EnMAP methane observations at Montemarta-Cónica Landfill. Four dated scenes show two positive methane detections and two scenes without a positive detection.

Table 3. DLR EnMAP observations and emission-rate estimates (Q ± σ).

Observation time (UTC)	Methane finding	Q ± σ (kg/h)	Q ± σ (t/h)
1 August 2024 11:47:21	No positive detection	—	—
18 January 2025 11:54:22	No positive detection	—	—
26 July 2025 11:54:22	Detected	2882 ± 691	2.88 ± 0.69
3 September 2025 12:05:45	Detected	1852 ± 513	1.85 ± 0.51

The two detected releases were estimated at 2,882 ± 691 and 1,852 ± 513 kg CH_4/h (2.88 ± 0.69 and 1.85 ± 0.51 t/h; Table 3). No observed detection does not mean that the site produced zero emissions. One of the lowest recorded detections using EnMAP was reported by Roger, Guanter and Gorroño (2025, Table B1), at approximately 600 ± 200 kg CH_4/h, and this should be regarded as the lowest detectable emission rate in ideal conditions.

Sentinel-5P regional composite

The wind-rotated Sentinel-5P composite combines 584 observations collected from January 2024 to October 2026. Figure 4 shows a coherent regional methane enhancement centred on Montemarta-Cónica Landfill. The coherent plume extends northward in the wind-rotated composite, corresponding to the aligned downwind direction.

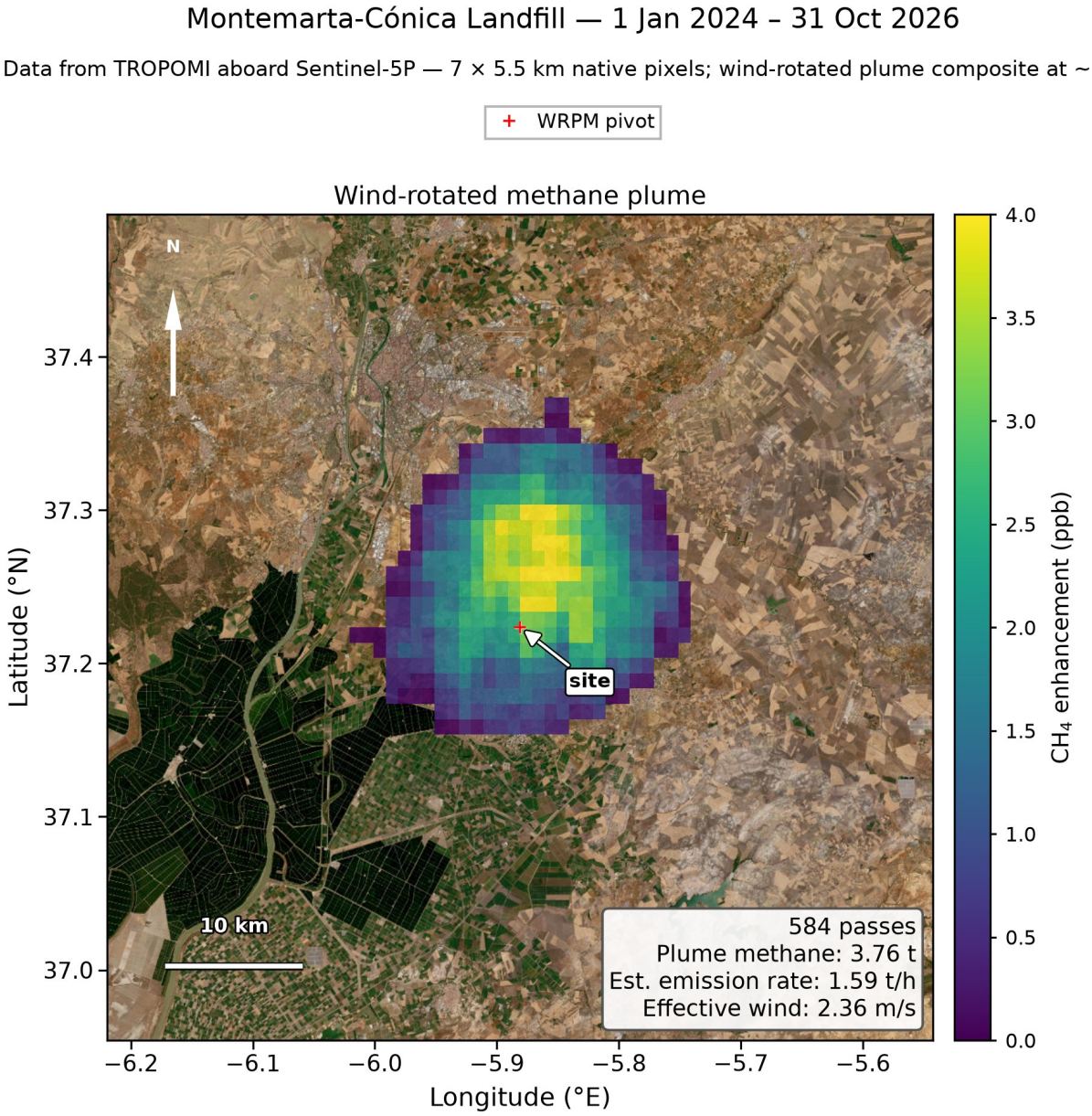


Figure 4. Sentinel-5P wind-rotated methane enhancement above the selected +4 ppb threshold within the connected plume (584 observations, January 2024 to October 2026), shown over aerial imagery. North in this display is the aligned downwind direction. Colour scale: methane above the selected threshold (ppb).

Table 4. Selected Sentinel-5P plume threshold and corresponding regional composite emission-rate estimate.

Selected excess	Confidence	Indicative IME rate
+4 ppb	High	1.59 t/h

How the Sentinel-5P analysis works

Landfill Sentinel used 584 Sentinel-5P methane observations collected from January 2024 to October 2026. Each daily observation was rotated about the facility according to the wind direction recorded for that day, so that the aligned downwind direction points to the top of the image and is displayed as north. That northward direction is the plotting convention of the wind-rotated composite. It is not a statement that the geographical wind blows north. The rotated observations were then averaged on a common grid of about 1 km to test whether a persistent methane enhancement appears downwind of the facility. Each Sentinel-5P pixel (about 7 × 5.5 km) spans several grid cells and the number of contributing observations varies across the map, so neighbouring cells are not independent measurements. The wind fields used to rotate the observations come from ERA5, the Copernicus climate reanalysis.

Figure 4 shows only the part of the wind-rotated composite that exceeds the selected threshold within the connected plume grown from the facility location, over aerial imagery. Other parts of the composite are not shown.

Operator confidence assessment

High confidence. The reviewing scientist assessed the signal as a spatially coherent methane enhancement associated with the facility and extending in the aligned downwind direction. This classification is the reviewing scientist's judgement of the spatial methane signal in the wind-rotated composite, made from the composite figures and the number of satellite observations supporting each part of the map. It is not a statistical confidence interval and does not describe the uncertainty of the emission-rate estimate.

Environmental significance

Methane is a powerful greenhouse gas. Over the twenty years after its release, a tonne of methane warms the climate around 80 times as much as a tonne of carbon dioxide, and around 27 to 30 times as much over a hundred years (IPCC, 2021). Methane has contributed roughly half a degree Celsius of the warming observed since pre-industrial times. Because it remains in the atmosphere for only about a decade, cutting methane emissions is one of the fastest ways to slow warming in the near term.

Landfills are among the largest human-caused sources of methane: organic waste decomposing without oxygen produces landfill gas, a mixture of methane and carbon dioxide.

At Montemarta-Cónica Landfill, releases of this magnitude were detected on four separate dates. Each estimate is a snapshot of one satellite overpass rather than an annual total.

The Sentinel-5P estimate of 1.59 t/h is different in kind. It is derived from the average methane enhancement in 584 Sentinel-5P observations combined over January 2024 to October 2026, so it describes the typical emission signal across those observations rather than continuous, hour-by-hour monitoring. It is reported separately from the snapshot estimates and is not averaged with them. It places the individual detections in context: the methane signal associated with the site is also present when many days are averaged, not only on the dates of the snapshot detections.

Operational and economic implications

Detecting methane does not, by itself, show that a facility is poorly managed. Methane is invisible, releases can be intermittent, and a large landfill has many possible emission pathways, from the waste surface and cover to extraction wells, pipework and gas-handling equipment. Ground surveys are valuable but cannot cover an entire site at every moment. Recent satellite instruments make it possible to detect and quantify releases that were previously difficult to observe, giving operators independent evidence that can help them locate and address emissions.

Methane is also the principal component of natural gas. Landfill gas that escapes to the atmosphere is energy that is not being collected for electricity, heat or biomethane production. Because methane was detected on several occasions, improving gas capture may bring operational and economic benefits as well as environmental ones.

Recommended actions

Discussion with the operator. Share the detection dates (31 May 2025, 22 June 2025, 26 July 2025 and 3 September 2025) with the site operator and compare them with operational records.

Gas collection review. Inspect the landfill-gas collection system, including extraction wells, pipework and possible leakage points, and review the flaring and utilisation systems and the effectiveness of the collection network.

Targeted measurements. Use ground-based or UAV methane surveys to locate the emission points on site. GeoKinsella works with IMMER Ltd (https://www.immerltd.com/), which can provide drone surveys of the site to localise methane leaks if required.

Continued satellite monitoring. Repeat the analysis with NASA EMIT, DLR EnMAP and Copernicus Sentinel-5P as new observations become available, to follow subsequent emissions and assess the effect of any corrective measures.

Conclusion

This investigation established that methane was released from Montemarta-Cónica Landfill on four separate dates, and that an independent multi-day Sentinel-5P analysis also associates a methane enhancement with the site. Repeated detections on separate dates, corroborated by an independent longer-term regional analysis, provide strong evidence of recurring methane emissions from Montemarta-Cónica Landfill. Improving gas capture would reduce the climate impact and recover energy that is currently lost.

Authorship

Prepared by Nicholas Kinsella FRGS. Satellite evidence: NASA EMIT, DLR EnMAP and Copernicus Sentinel-5P.

About GeoKinsella

Satellite methane detection, remote sensing and geospatial analysis

WHO WE ARE

GeoKinsella is a specialist consultancy led by Nicholas Kinsella FRGS, focused on detecting and quantifying methane emissions through satellite Earth observation and geospatial analysis.

WHAT WE PROVIDE

Satellite methane screening, source assessment and emissions quantification using Sentinel-5P, NASA EMIT and DLR EnMAP, supported by geospatial analysis and scientific reporting.

GeoKinsella.net

References

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