Supporting Information

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Gaussian Integral Flux Inversion Method (Mass Balance Approach)

The flux inversions were calculated using a mass balance approach (*Materials and Methods*). Here, we show a few plume examples including the chosen cross-tracks. For each example, an overview of the cross-tracks, an exemplary cross-track with the corresponding background fit, the resulting emission rates per track, and the mean values are presented. The error is calculated as the 1σ SD of the flow rates of all single cross-tracks. The flow rates calculated are in grams per second per wind speed meters per second, i.e., relative to wind speed. For comparison with Fig. 3, the flow rates are multiplied by the assumed wind speed of 2 m/s. To illustrate the Gaussian integral inversions, we will show two examples, namely, the strongest source (coal mine venting shaft) as well as a weaker well pad emission.

Venting Shaft. The cross-track region was divided into two parts, due to missing retrieved data over a water basin, which is black in the near-infrared. The cross-tracks defined orthogonally to the main plume direction are displayed in white (Fig. S1). The first part contains 66 cross-tracks, and the second part contains 123 cross-tracks.

	Flow rate per meters per second wind speed, g/s/(m/s)	Flow rate for 2-m/s wind speed, kg CH_4/h
Mean flow rate (first part)	(225 ± 47)	(1622 ± 336)
Mean flow rate (second part)	(233 ± 94)	(1680 ± 676)

Intermediate Plume. This plumes indicates leakage of a well pad. We used 41 cross-track elements to determine the flow rate.

	Flow rate per meter per second wind speed	Flow rate for 2-m/s wind speed
Mean flow rate (first part)	(86.2 ± 50) g/s/(m/s)	(621 ± 359) kg CH_4/h

Potential Additional Pipeline Leaks

Two confirmed pipeline leaks were detected with AVIRIS-NG during the flight campaign and communicated to the operating company (Movie S2). Two additional potential pipeline leaks identified during preparation of this manuscript were also reported to state authorities. These examples appear at locations where there is no clear evidence of facilities that might generate these emissions. The first example is shown in Fig. S6, *Left* from a 20 April flight, where a plume is clearly visible with methane concentrations in excess of 8,000 ppm/m. The plume appears to be associated with a subtle linear feature that could indicate a buried pipeline that is visible in both the AVIRIS-NG true color image and the Google Earth imagery. In Fig. S6, *Right*, a second potential pipeline leak was identified in a steep-sided channel based on well-defined plumes observed by both HyTES and AVIRIS-NG on 23 April. This location, however, was confirmed to be a natural methane seep in the area.

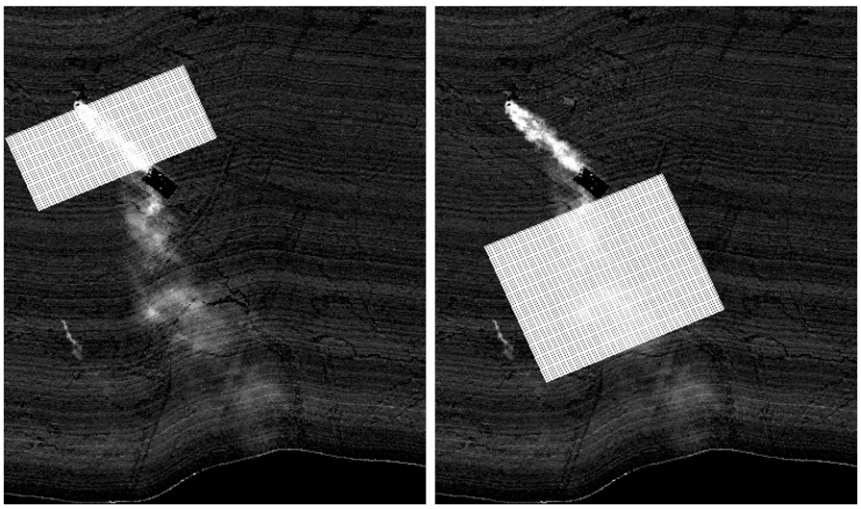

Fig. S1. Cross-track regions defined for the coal mine venting shaft plume for the first part (*Left*) and second part (*Right*).

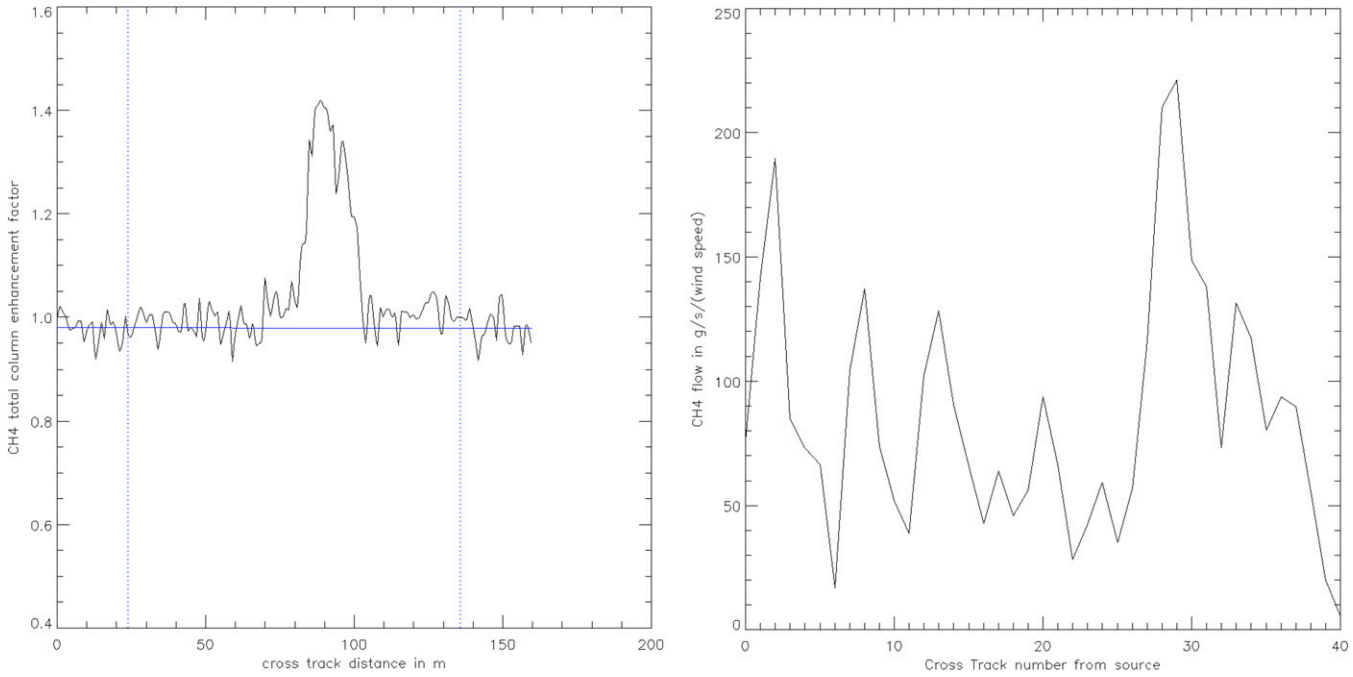

Fig. S2. (*Left*) Exemplary cross-track with background fit (blue), background region outside the dotted area, and scaling factor for CH_4 over the cross-track distance. (*Right*) Overview over the flow rates in grams per second per wind speed meters per second over all cross-tracks of the first part.

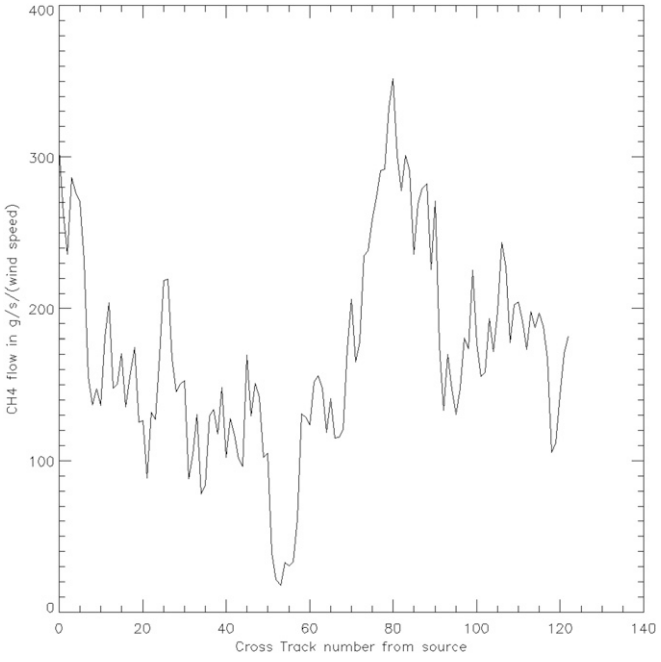

Fig. S3. Overview over the flow rates in grams per second per wind speed meters per second over all cross-tracks of the second part.

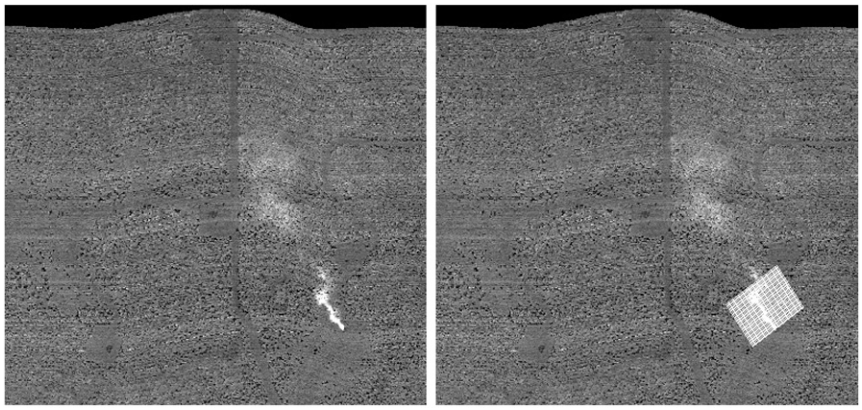

Fig. S4. Cross-track regions defined for the coal mine venting shaft plume.

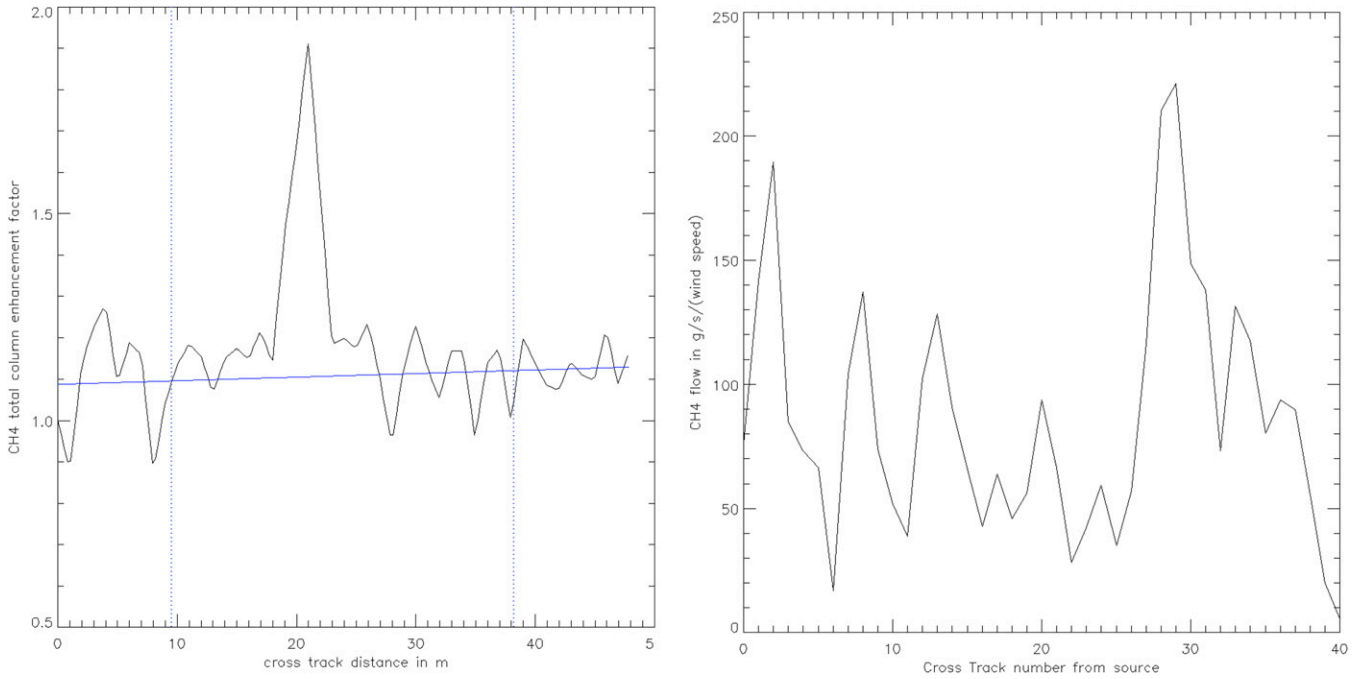

Fig. S5. (*Left*) Exemplary cross-track with background fit (blue), background region outside the dotted area, and scaling factor for CH_4 over the cross-track distance. (*Right*) Overview over the flow rates in grams per second per wind speed meters per second over all cross-tracks of the first part.

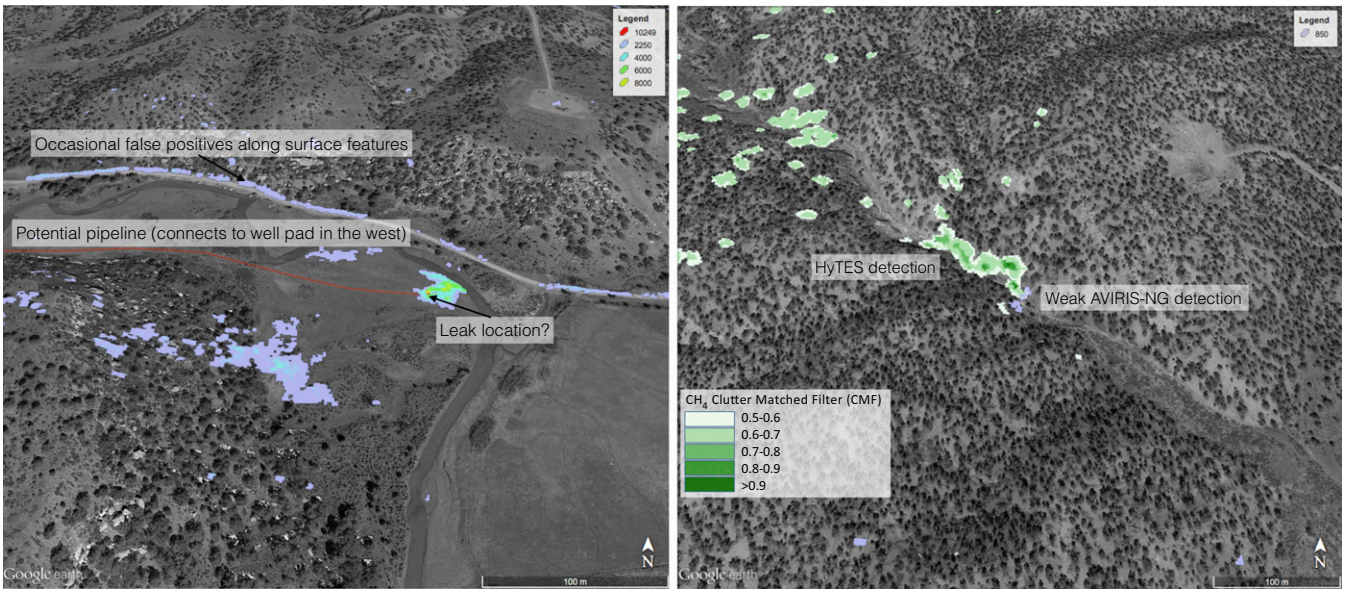

Fig. S6. (*Left*) Methane plume observed by AVIRIS-NG for possible pipeline leak. Subtle linear feature visible in Google Earth imagery may indicate a buried natural gas pipeline. Right: Methane plumes observed by HyTES (green) and AVIRIS-NG (purple) for possible pipeline leak located in a steep-sided channel. Less clear than previous location but detected with both sensors.

Movie S1. Thermal video obtained of an identified HyTES methane plume emanating from a storage tank. A Xenics Onca-VLWIR-MCT-384 thermal imaging camera with a Spectrogon optical filter centered at 7.746 microns was used to qualitatively display methane.

Movie S1

Movie S2. Thermal video of methane emanating from an underground pipeline leak detected with AVIRIS-NG. The location was reported to the operating company, which shut down the pipe and commenced repair the day after. A Xenics Onca-VLWIR-MCT-384 thermal imaging camera with a Spectrogon optical filter centered at 7.746 microns was used to qualitatively display methane.

Movie S2

Movie S3. Thermal video of methane emanating from an underground storage tank detected with AVIRIS-NG. The location was reported to the operating company, which shut down the pipe and commenced repair the day after. A Xenics Onca-VLWIR-MCT-384 thermal imaging camera with a Spectrogon optical filter centered at 7.746 microns was used to qualitatively display methane.

Movie S3