

# Combining TROPOMI with high-resolution satellite data to dissect methane point emissions on the West Coast of Turkmenistan

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# Monitoring methane point emissions in the West Coast of Turkmenistan

→ The study area in the West Coast of Turkmenistan is a desertic region with high O&G activity, which has been identified as a methane emission hotspot region.

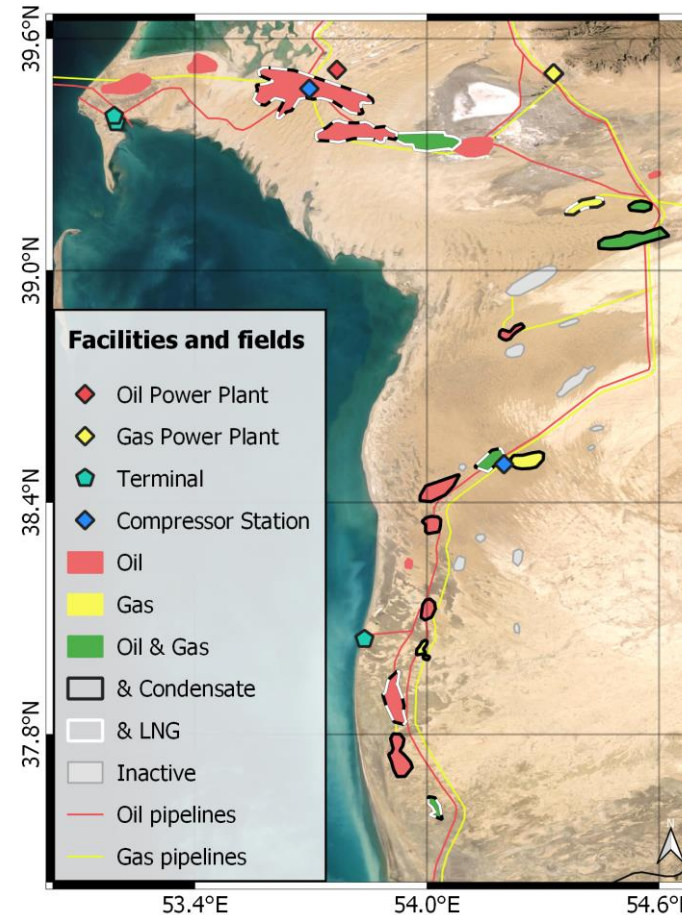
→ We have combined three types of satellite data:

⇒ **TROPOMI** data: 7-5 km spatial resolution, daily and global scale.

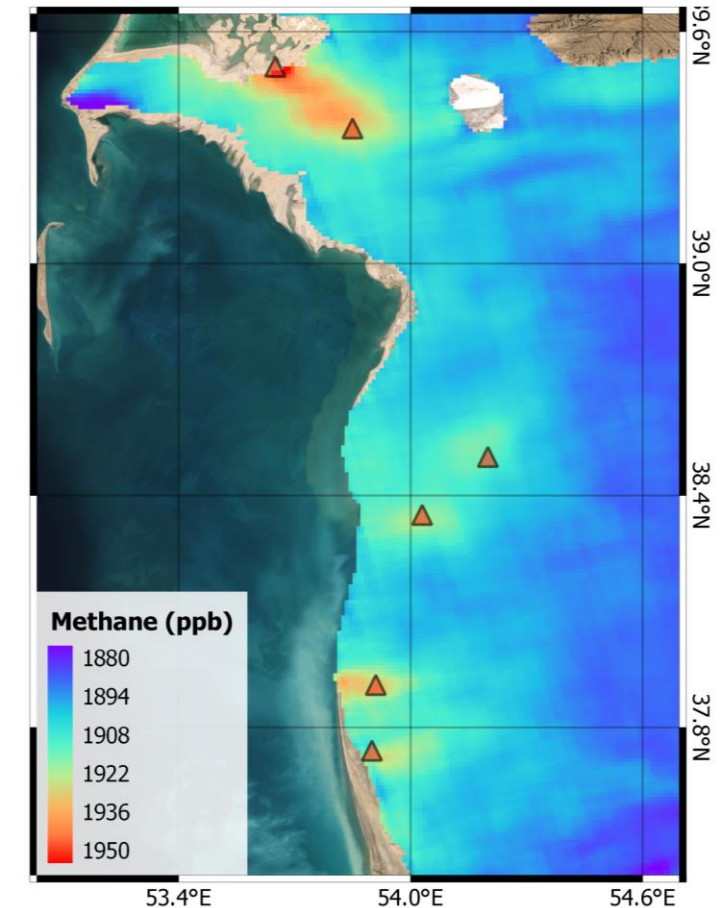
⇒ Hyperspectral data from **ZY1** and **PRISMA**: 30 m spatial resolution, medium sensitivity (~500 kg/h) with sporadic acquisitions.

⇒ Multispectral data from **Sentinel-2** and **Landsat**: 20-30 m spatial resolution, low sensitivity (~1500 kg/h) but frequent and global coverage.

→ This synergy allows us to detect, quantify and monitor emissions over the study area.

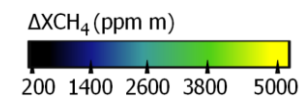
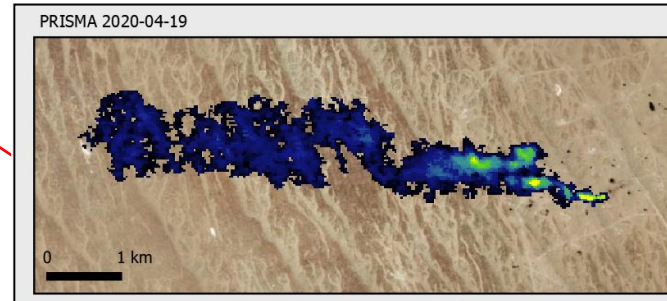
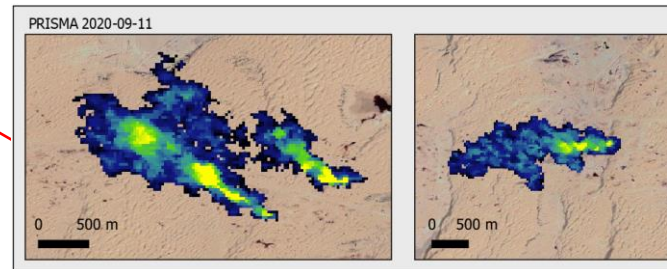
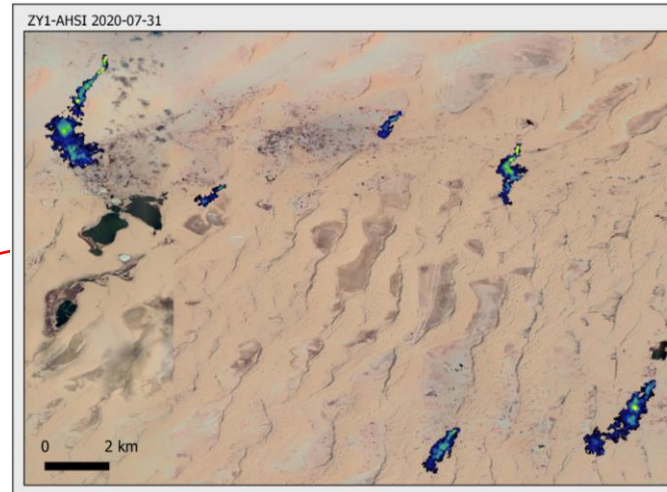
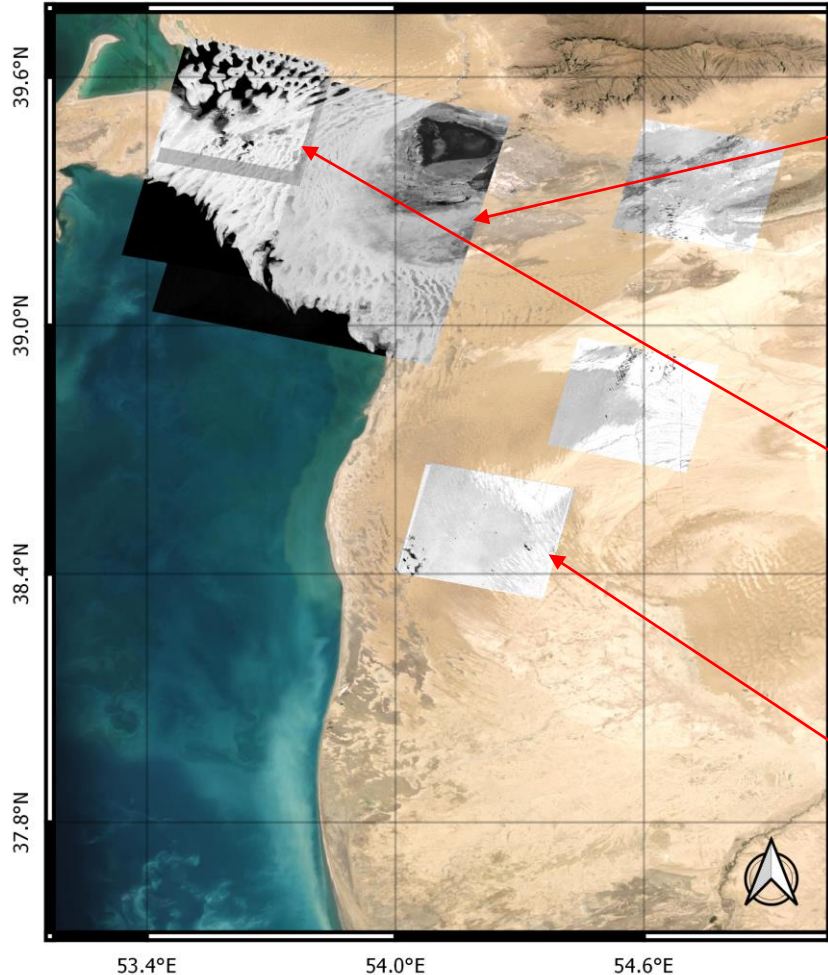


O&G fields thorough the study area.



TROPOMI 0.1° grid oversampled map from Nov. 2018 to Nov. 2020 with the locations pinpointed by TROPOMI.

# Hyperspectral data



- We have used the Chinese ZY1 mission and the Italian PRISMA mission which sample the 2100-2450 nm window with tens of spectral channels.
- We have applied a data-driven method (Matched Filter) for methane retrieval.

From:

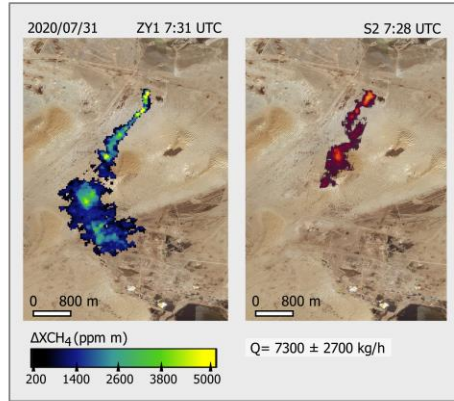
- 1 ZY1 image of 60 x 60 km<sup>2</sup>
- 12 PRISMA images of 30 x 30 km<sup>2</sup>
- During 2020

We obtained:

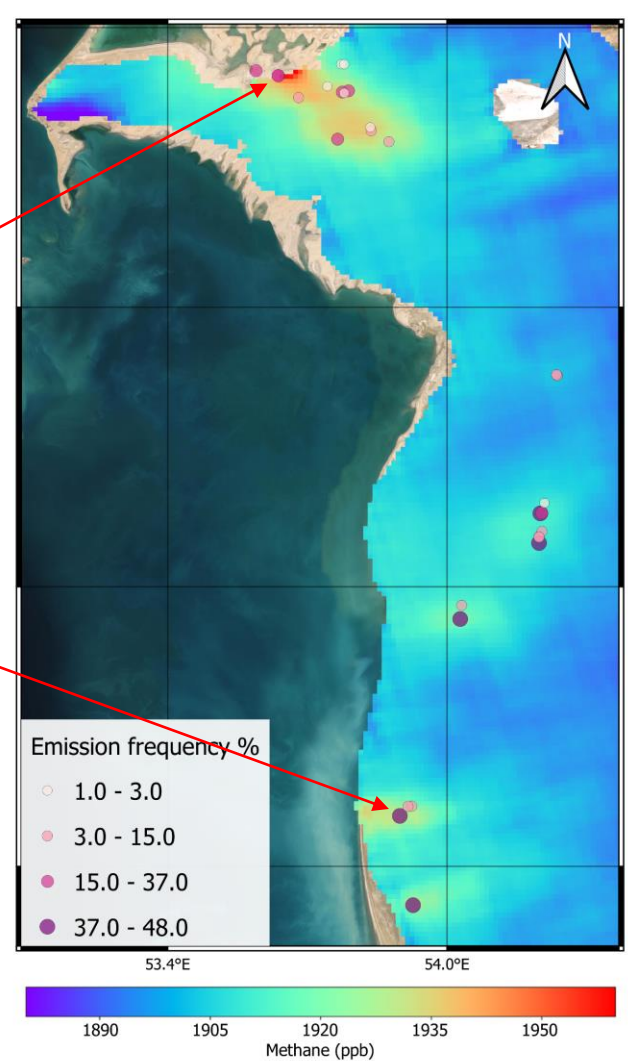
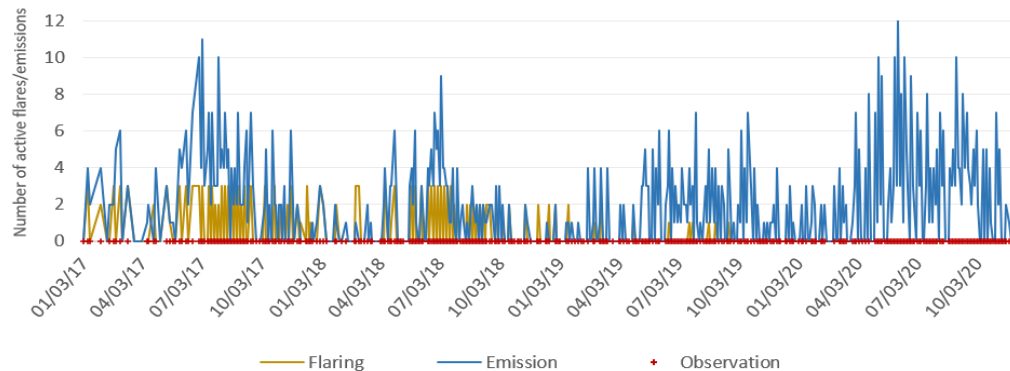
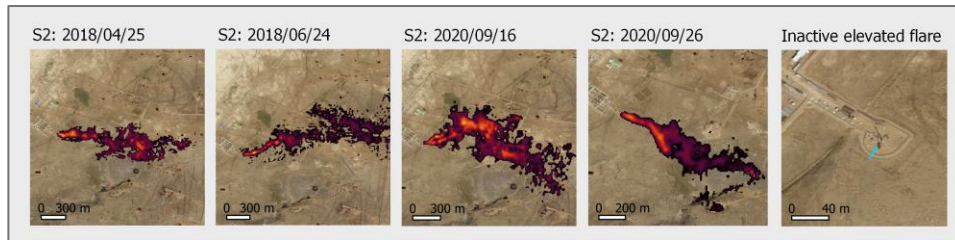
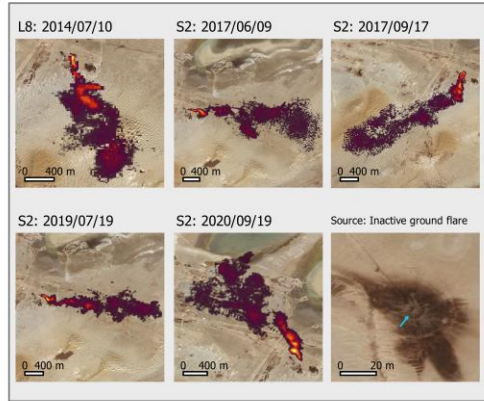
- 25 plumes from 10 different sources
- Emission fluxes between 1.400 ± 400 kg/h - 19.600 ± 8.000 kg/h

# Multispectral data

## Detection & quantification



## Monitoring & attribution



→ We have used the B12 (~2190 nm) / B11 (~1610 nm) band ratio to detect the emissions.

## S2 monitoring:

- From Jan 2017 to Nov 2020
- 944 CH<sub>4</sub> plumes
- From 29 emission sources
- 2020 the year with most emissions

## Sources:

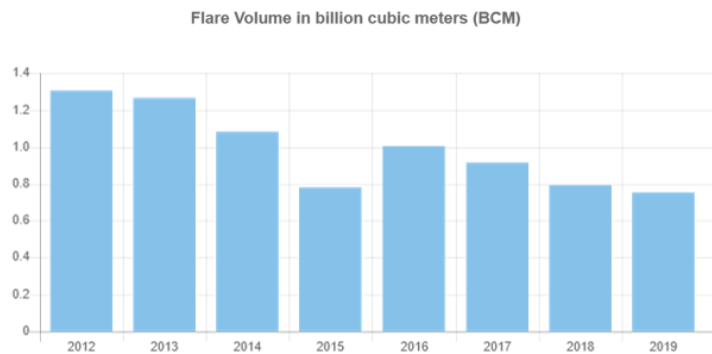
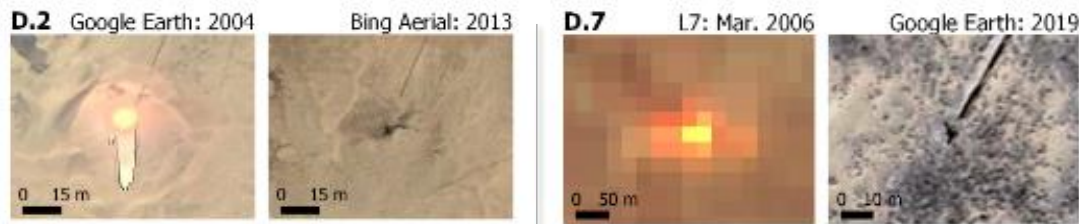
- 24 flares
- 2 pipelines
- 3 unknown

All located in oil fields, except for one that produces both gas and oil.

# Further results

## Decrease of the flaring at the cost of venting.

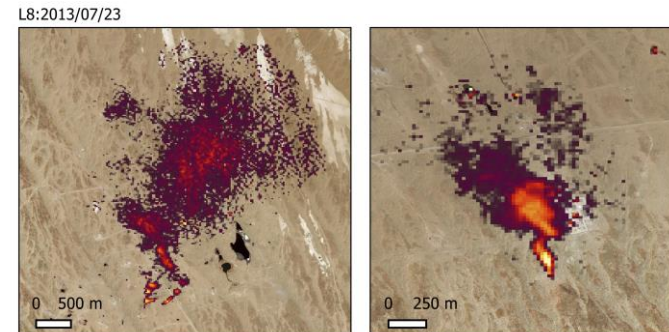
- Nine emitters have had active flaring in the past.
- According to VIIRS data, flaring has been declining since 2012.



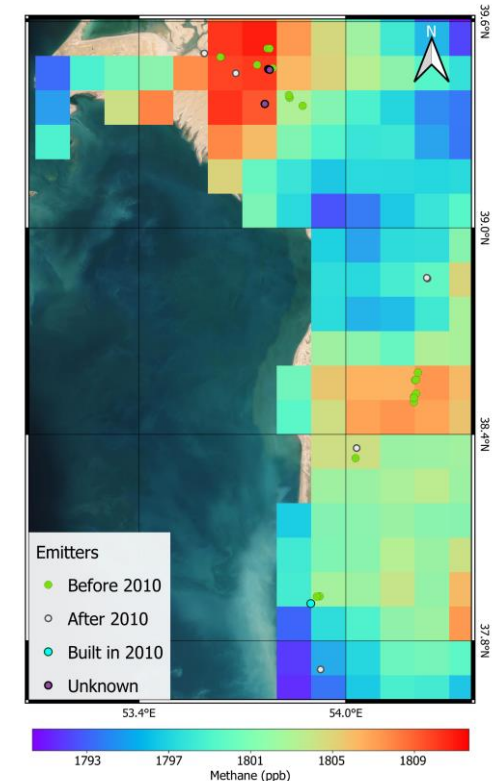
VIIRS data from 2012 to 2019 (most recent available data).

## Long-standing emissions.

- 15 sources record emissions before 2017.
- 2003-2010 SCIAMACHY data is consistent with the age of the emitters identified in the study.



Examples of Landsat-8 detections in 2013.



SCIAMACHY data oversampled to a  $0.1^{\circ}$  grid between 2003 and 2010 combined with the existence of the emitters.

- More details about the study in preprint version: <https://doi.org/10.31223/X56G7R>

# Take home messages

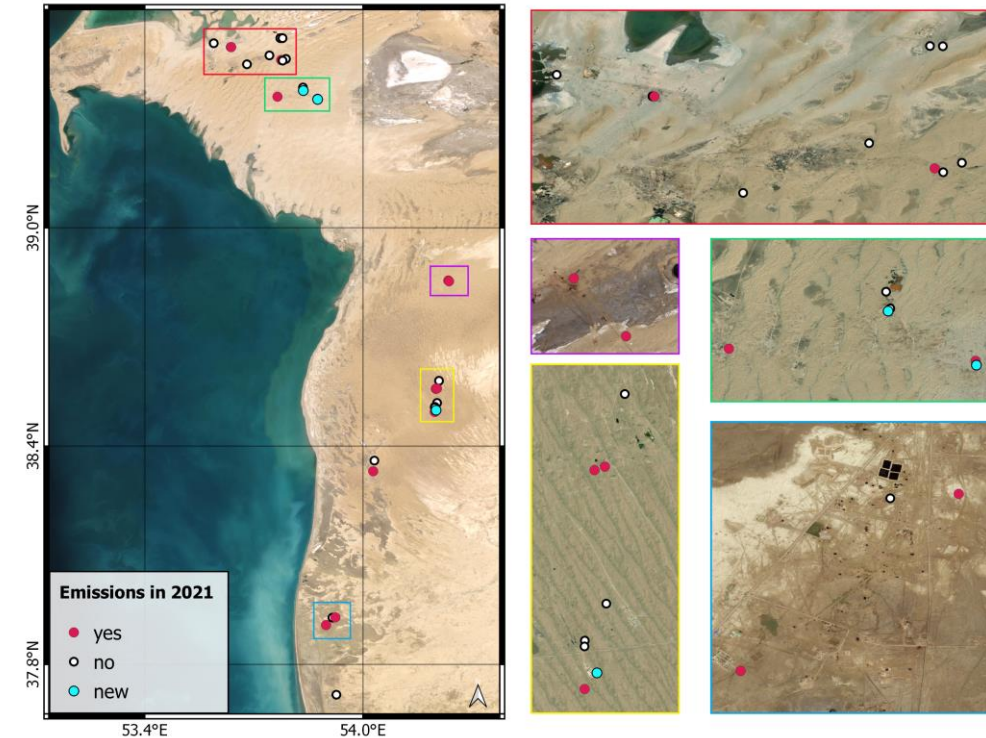
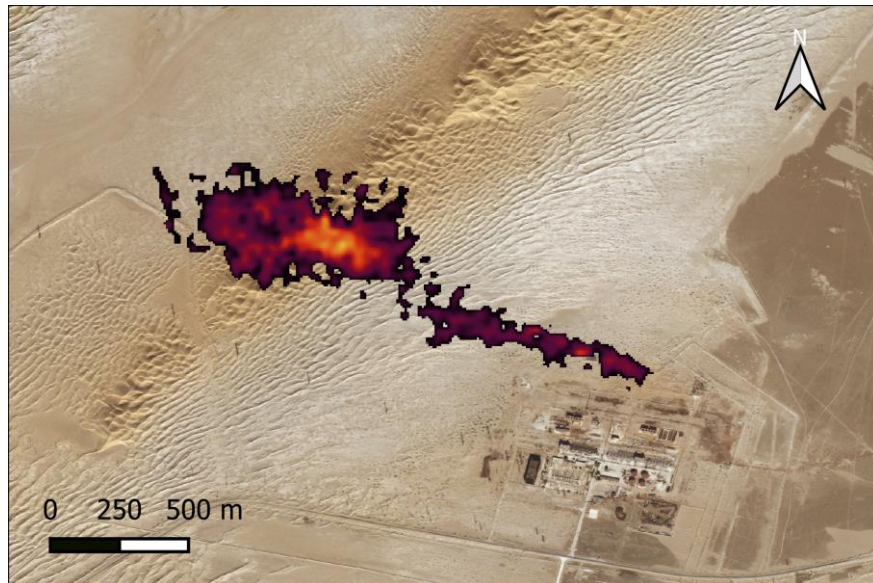
→ We have exploited the synergy between 3 types of methane-sensitive remote sensing datasets.

→ So far this year:

⇒ 12 of the 29 emitters identified during the study continue recording emissions.

⇒ Three more additional sources have been found: 2 pipeline leaks and one flare.

→ The detected emitters are being reported to the corresponding organizations so they can be fixed.



→ We are applying this methodology in other countries and extending the timeline in Turkmenistan using Landsat historical data.

← Landsat-5 detection on 2000/03/13 near two emitters identified during the study.