TECHNOLOGIES FOR DETECTION, MEASUREMENT AND QUANTIFICATION OF METHANE EMISSIONS IN THE MIDSTREAM SECTOR

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Methane Mondays

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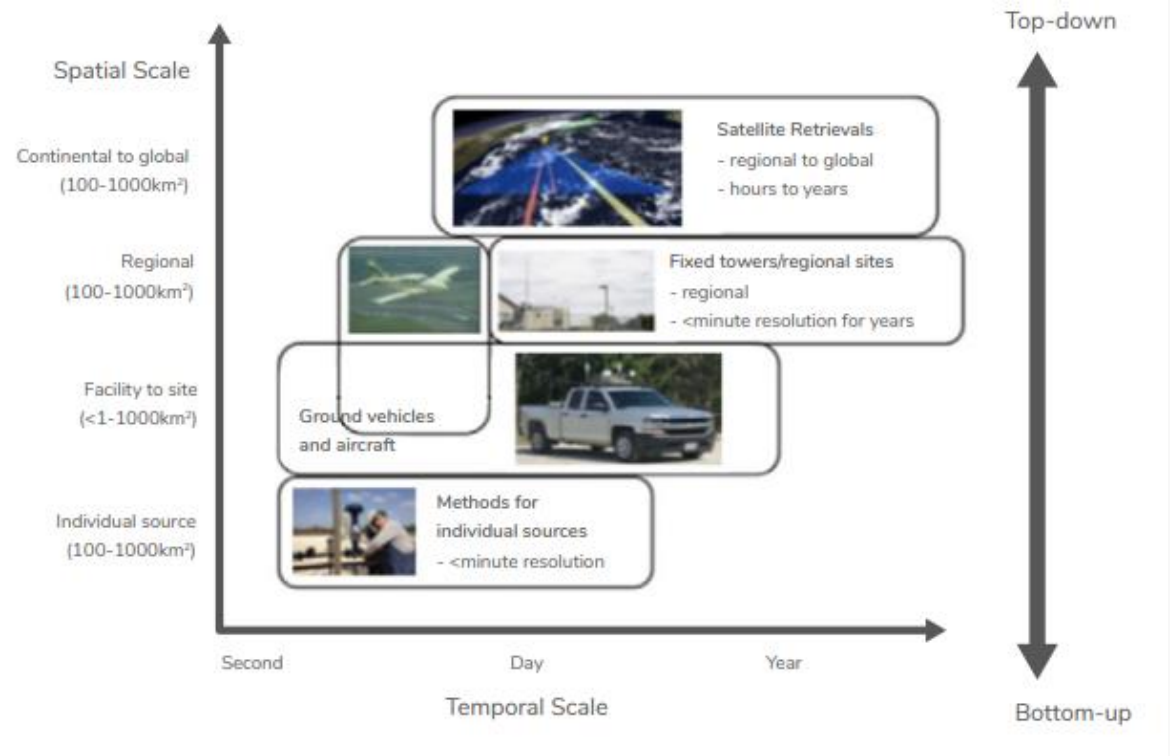
HOW CAN THE DETECTION AND MEASUREMENT OF METHANE EMISSIONS BE PERFORMED?

The detection and measurement of methane emissions can be either bottom-up or top-down and can be done in several ways :

- Foot survey (individual sources)
- Fixed location (stationary detectors on sites, unusual events)
- Wheeled vehicles
- Drones or UAV's
- Aircraft
- Satelites



Source: metheneguidingpronciples.org

SURVEY BY A PERSON ON FOOT, USED FOR INDIVIDUAL SOURCES (BOTTOM-UP)

Example of Technology	Measurement/ quantification method	Accuracy of quantification	Advantages and disadvantages
Sniffer sampler e.g. FID, laser, high-sensitivity semiconductor detectors, that sample the concentration of methane in the air	Indirect. Through use of a correlation equation that relates concentration to rate, or through use emission factors	Medium to high	**Advantage**: Well documented methods exist, models/correlation factor of EN15446, which is an indirect quantification methodology **Disadvantage**: post survey calculations and correlations must be used. correlation factors are not well adjusted for the gas industry
Flow sampling (a device pulls in enough air to capture the entire emission)	Direct	High	**Advantage**: Realtime emission rate **Disadvantage**: Hi-Flow™ Sampler (HFS) device has been discontinued; time consuming
Optical-gas imaging combined with image processing (OGI+QOGI) (emerging technology)	Indirect	Low to medium	**Advantage**: realtime emission rate, at distance **Disadvantage**: low confidence level; highly dependent on environmental conditions; poor for extremely large leaks; requires specific training

SURVEY BY A PERSON ON FOOT, USED FOR INDIVIDUAL SOURCES (BOTTOM-UP)

Example of Technology	Measurement/ quantification method	Accuracy of quantification	Advantages and disadvantages
Calibrated bags	Direct	High	**Advantage:** Inexpensive materials, accurate **Disadvantage:** Time consuming and labor intensive
Ultrasound imaging (emerging technology)	Indirect	Low to medium	**Advantage:** Realtime, fast **Disadvantage:** can be disturbed by other noises; requires certain pressure drop

Each device has advantages and limitations, from our experience the assessment of methane emissions from gas transmission infrastructure components requires the use of at least two different devices.

EXAMPLE #1 - COMPRESSOR STATION

Leakage at the fuel hose connection		
Device	Acoustic camera	OGI camera +software
Result [l/min] *converted	0,25*	
Description	Natural gas leak first detected by OGI (but failed to quantify), later detected by the acoustic camera and verified with the sniffer.	

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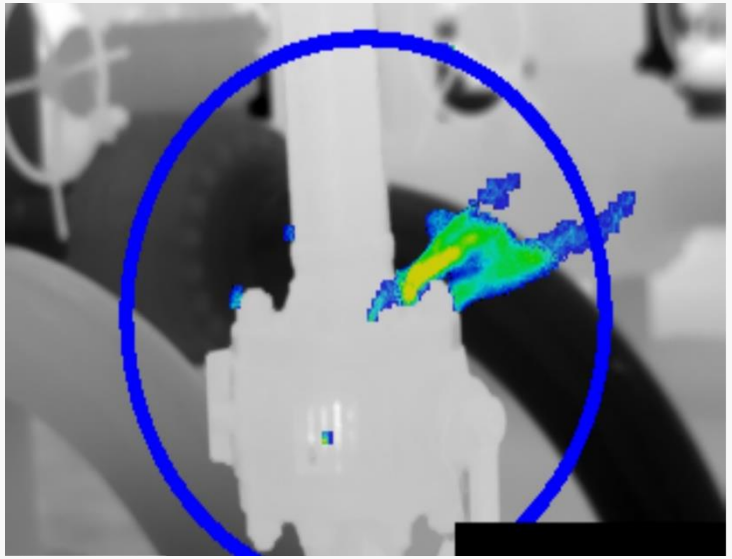
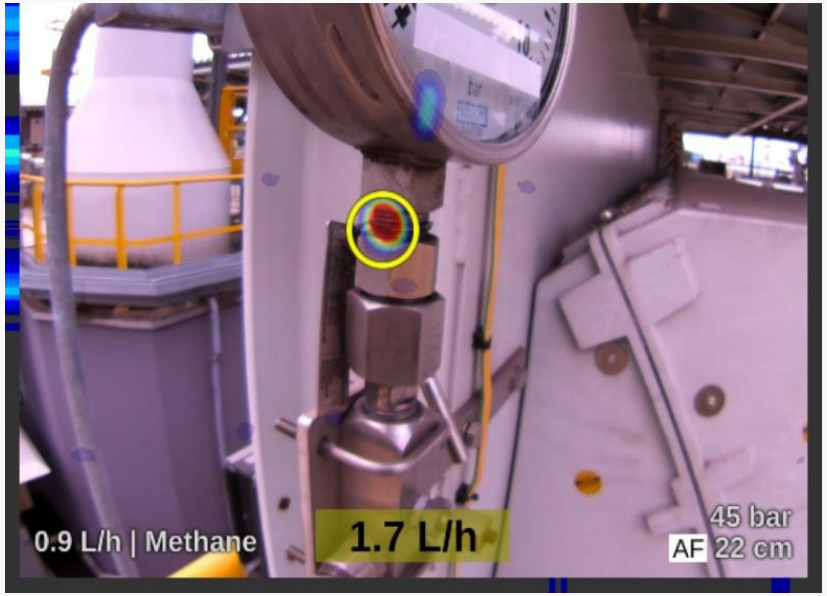
EXAMPLE #2 - GAS NODE STATION

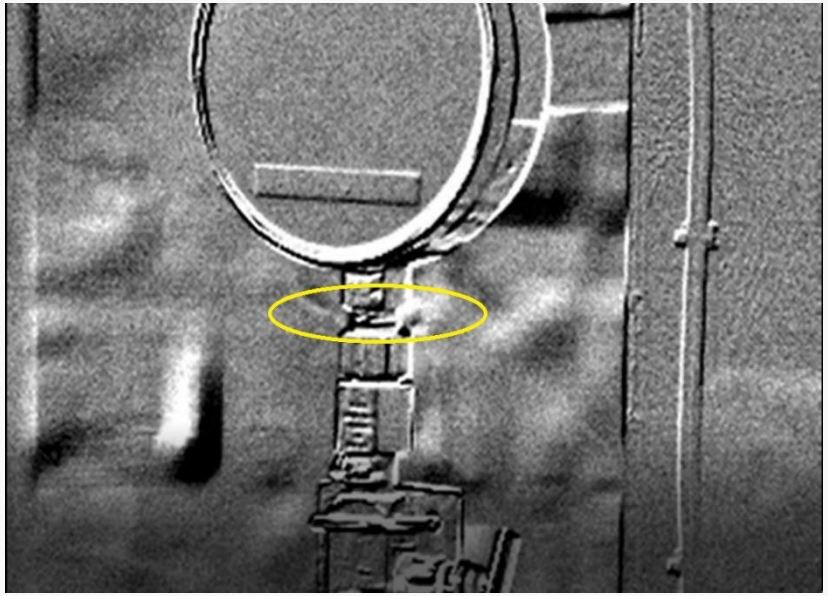
Red bolt on the flange at pipeline		
Device	Acoustic camera	OGI camera +software
Result [l/min] *converted	0,092*	0,028
Description	The leak was first detected by a OGI camera, then by an acoustic camera and confirmed as methane emissions by sniffer detector. Quantitatively, the result was obtained with the acoustic camera. The software application due to the very small leak and the indistinct plume was able to quantify the methane emission only once for a very short time.	



EXAMPLE #3 - GAS STATION

Pressure gauge		
Device	Acoustic camera	OGI camera +software
Result [l/min] *converted	0,028(3)*	0,52
Description	Leakage occurs at the connection between the pressure gauge and the valve block.	





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CONCLUSIONS

- The detection capabilities of acoustic camera were negatively influenced by additional ultrasound sources from noises at the facility, running compressors, pressure reductors cause difficulties. The presence of loud sound sources (being a leak, flow noise or other) could sometimes prevent detecting smaller leaks, especially on flanges or open-ended lines. Different strategies such as changing the detection frequency or covering the sound emitted by the strong sources can be applied to overcome this limitation. However, this did not help in all the cases. The camera detected some vibrations, reflections, and flow noise as well, but in general it was easy to differentiate these indications from gas leaks.
- In the case of the OGI camera, the leak detection capabilities were negatively impacted by winds, specially by strong changing directions winds, intense sunlight or no sunlight at all, and all other requirements to have a temperature difference of more than 2°C between the leak and ambient temperature. Detecting leaks in installations covered with a heat-insulated shield with metallic sheeting was difficult due to reflections.
- OGI cameras require much more training and expertise than the acoustic cameras

CONCLUSIONS

- For the leaks whose rate was quantified with both techniques, no agreement was found between both techniques, being the leak rates estimated by the acoustic camera always lower than those estimated by the OGI camera. The operators had the impression that the ultrasound camera was underestimating some leak rates. This observation was verified on a leak on an open-ended line. However, it must be noted that, except from this open-ended line leak, no ground truth was available to compare the quantification accuracy of the tested techniques.

- Currently, there is no equipment on the market that can easily measure emissions with sufficient accuracy for all cases occurring at transmission network facilities, however, many technologies are currently being developed.

THANK YOU FOR YOUR ATTENTION

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