geoconvention
Calgary • Canada • June 20-22 2022

A comprehensive summary of methane quantification using Telops' airborne hyperspectral instrument

Jean-Philippe Gagnon, Vincent Farley, Stéphane Boubanga-Tombet
Telops

Summary

Methane is a powerful greenhouse gas and several organizations in multiple countries are taking significant steps toward sharply reducing emissions from the oil and gas sector [1] [2]. A large portion of such emissions come from a small fraction of "super-emitting" sources. Airborne infrared hyperspectral imaging can visualize and quantify these emissions and gas leaks under various environmental conditions and industrial contexts. The capabilities of the Telops airborne-based methane emission detection system was demonstrated in multiple controlled releases with methane flow rates varying from 3 to 55 m3/h. Results show that the system is able to detect methane emission rates as low as 3 m3/h. This is in good agreement with performance simulations. The system's detection limit depends on atmospheric parameters such as wind speed, humidity and thermal contrast. Emission rate quantification accuracy depends on the wind measurement accuracy, the fit of the results show a parity slope of 0.99 (R2 = 0.89), thus very good agreement between commanded leak rate and retrieved leak rate.

Theory / Method / Workflow

According to EPA (United States Environmental Protection Agency), methane accounts for 10% of total greenhouse gas emissions whereas carbon dioxide amounts to 80% [3]. However, the fact that methane has a global warming potential that is 28–36 times that of carbon dioxide over a 100-year period [4] is a strong motivation for reducing emissions. A large portion of the methane emissions come from the energy sector, more precisely from natural gas and petroleum industry. The oil and natural gas industry includes a wide range of operations and equipment, from wells to natural gas gathering lines and processing facilities, to storage tanks, and transmission and distribution pipelines, all of which can leak methane into the atmosphere.

Recent work indicate that a small number of point sources (10%) are responsible for most (60%) of the methane emissions [5] [6]. These sources are called super-emitters. Several technologies exist to detect those emissions. Airborne longwave infrared hyperspectral imager like the Hyper-Cam Airborne Mini is one of them. This technology was evaluated and its capabilities demonstrated in multiple methane-controlled releases. In this work we want to present a comprehensive summary of the detection and quantification results obtained in recent campaigns.

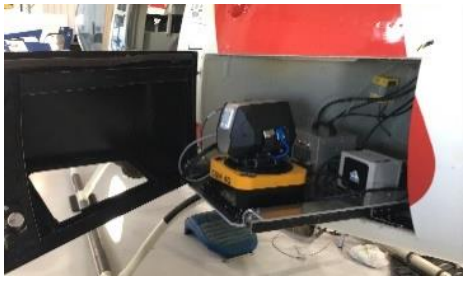

Figure 1. Example of integration of the Hyper-Cam Airborne Mini: (upper image) in an ARLA 600 from Asman Technology; (lower image) in a Bell 206 helicopter.

Results, Observations, Conclusions

Results presented in this paper come from 4 different airborne data collection campaigns at various locations. Figure 2 presents the retrieved leak rate values for positive detections during the 4 controlled methane release campaigns. In the summary graph, there are 78 datapoints from a commanded release rate of 3 m^3/h to 54.8 m^3/h. Results show a strong correlation between the calculated leak values and the commanded leak rate values.

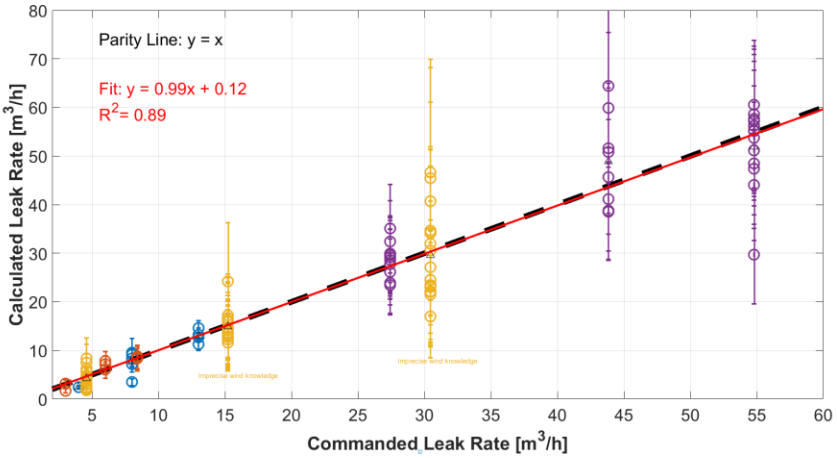

Figure 2. Parity chart of commanded methane leak rates and the corresponding reported calculated leak rate in m3/h. The y = x parity line indicates perfect quantification. Results show a close linear fit and good agreement between commanded and reported leak rates. The color of the data points indicates to which data collection campaign they belong.

Novel/Additive Information

Accurate methane detection and quantification using hyperspectral airborne technology.

References

[1] EPA Proposes New Source Performance Standards Updates, Emissions Guidelines to Reduce Methane and Other Harmful Pollution from the Oil and Natural Gas Industry https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/epa-proposes-new-source-performance.
[2] Canada confirms its support for the Global Methane Pledge and announces ambitious domestic actions to slash methane emissions https://www.canada.ca/en/environment-climate-change/news/2021/10/canada-confirms-its-support-for-the-global-methane-pledge-and-announces-ambitious-domestic-actions-to-slash-methane-emissions.html.
[3] EPA website (https://www.epa.gov/ghgemissions/overview-greenhouse-gases).
[4] IPCC's Fourth Assessment Report - Errata (IPCC 2012) (https://www.ipcc.ch/report/ar4/wg1/).
[5] Duren, R.M., Thorpe, A.K., Foster, K.T. et al. California's methane super-emitters. Nature 575, 180–184 (2019).
[6] Frankenberg, C. et al. Airborne methane remote measurements reveal heavy-tail flux distribution in Four Corners region. Proc. Natl Acad. Sci. USA 113, 9734–9739 (2016).