METHANE FROM FLARING TOOLKIT

Measure Efficiency: Drone equipped with dual CH4 and CO2 sensors

Summary

Drone mounted combined CH_4 and CO_2 are flown downwind of a flare measuring directly the combustion efficiency as the ratio of the two compounds. The use of drone technology enables close proximity sampling of the flare that can be adapted to changing environmental conditions and flow rates.

Drone deployment reduces the complexity of using alternative airborne methods (see separate entries). However, because drones have a smaller payload the sensor package has to be used that is much lighter. This precludes the use of many research-grade instruments.

The sensor technologies can also be used for other methane measurement requirements such as LDAR.

How it Works

Ultra-light sensors (e.g. dual tuneable diode laser absorption spectrometer) measure simultaneously CH4 and CO_2 concentration at high frequency and high sensitivity. The sensor is integrated into a drone allowing 3D detection and mapping of emission plumes as well as local concentration background.

Relative concentration measurement over background is possible by conducting upwind measurements.

Rapid data relay provides a real-time direct measurement of CH4 and CO_2 concentrations into the emission plume and the molar ratio of CH4 over CO_2 from combustion sources emission which can be derived to CH4

destruction efficiency and combustion efficiency.

Total emission rates measurement are based on a mass balance method using accurate wind measurements or by reference to the metered flow of gas.

Advantages

- Example technologies have been performance tested against other methodologies at controlled gas release field test (e.g. TOTALENERGIES TADI facility)
- Example technology tested over various real site source types (flares vents fugitives) and environments both onshore & offshore
- Measurement can be spot campaign or can be made continuous through autonomous drones technology
- CH4 to CO_2 concentration ratio obtained at spatial high resolution provides deeper insight into emission apportionment between multiple sources among an industrial site
- Reduces the complexity of deploying ships or aircraft to conduct measurements
- Accurate compared with fixed sensor or satellite measurements
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Technology can also be used for LDAR and other methane measuring activities

Limitations

- Cannot measure during rainy conditions or heavy fog
- Depends on drone flight capability against weather
- Cannot measure the concentration of CO so that Destruction Efficiency determination is relying on CO concentration assumptions
- Unless the flare is metered accurately, the total methane emissions require the addition of dispersion modelling, which increases the uncertainty of the total method

Go Deeper

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Case study

AUSEA

AUSEA stands for Airborne Ultralight Spectrometer for Environmental Applications developed by TotalEnergies and the GSMA laboratory, a joint research unit of the French National Center for Scientific Research (CNRS) and University of Reims Champagne Ardenne.

AUSEA is a TotalEnergies proprietary emission quantification & detection system based on a dual sensor carried on a drone capable of measuring simultaneously at high frequency CH4 and CO_2 concentrations at high

sensitivity against background and advanced wind measurements. Thanks to the versatility of the drone, a large panel of sources emissions can be measured from fugitives to flare emissions. The result is a direct measurement of emitted or residual CH4 and CO_2 from sources and for combustion sources it also provides measurements of combustion and destruction efficiency.

AUSEA dual sensor drone was deployed during a 3 days campaign on a conventional oil onshore treatment plant. The CO_2 and CH4 emission rates for the whole site could be determined with specific contribution of flares and other combustion sources (gas turbines and/or boilers) among other fugitives CH4 emissions.

Different flaring conditions over the 3 days allowed to measure respective combustion and destruction efficiency regime within a range of 96.6% (+/-0.5%) to 99% (+/- 0.1%).

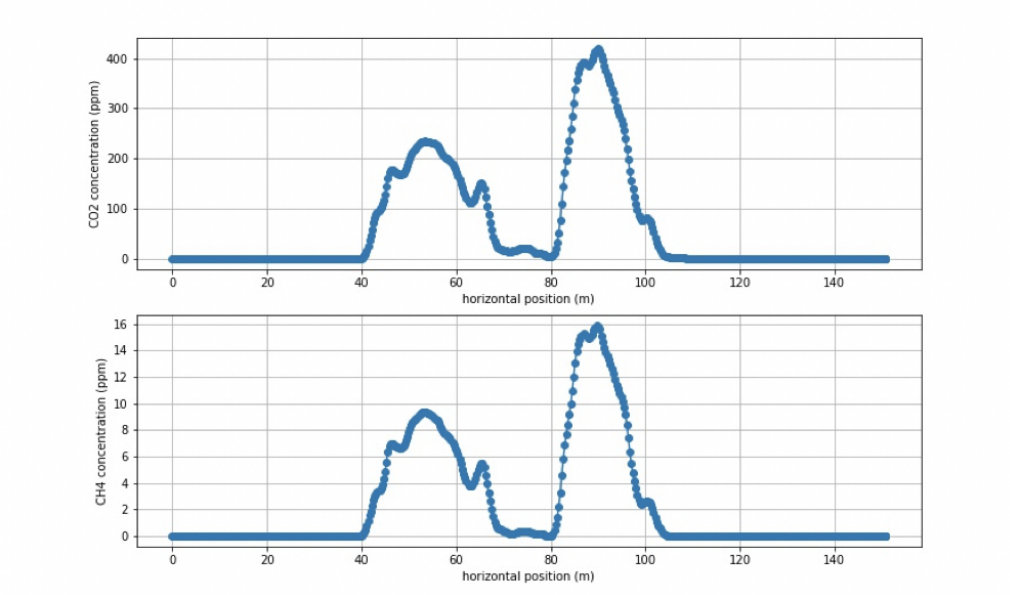

Figure 1: example of CO_2 & CH4 simultaneous concentration enhancements over background measured across a flare plume (Multiple flaretip stack)

The results could identify that air LP flares would benefit from a lower Air assistance flowrate.

Can I measure flare efficiency?

Measure Efficiency: Predictive Feedback and Control

Measure Efficiency: Flare Simulations

Measure Efficiency: Drone equipped with single methane sensor

Measure Efficiency: Aerial measurement of flare efficiency