Alberta Methane Field Challenge – June 2019

Final Summary Report

Prepared for:
Petroleum Technology Alliance of Canada
Suite 400, Chevron Plaza
500-5 Avenue SW
Calgary, Alberta, Canada
T2P 3L5

Prepared by:
Thomas Barchyn
University of Calgary
Calgary, Alberta, Canada
tbarchyn@ucalgary.ca

Introduction

The objective of the Alberta Methane Field Challenge (AMFC) was to better understand the real-world utility of emissions measurement systems for helping to reduce methane emissions from the upstream oil and gas sector in Canada. A suite of selected technologies were deployed to operating oil and gas sites and tasked with detecting, measuring, and localizing emissions sources in an intensive fieldwork campaign from 10-21 June 2019. The University of Calgary Portable Methane Leak Observatory (PoMELO) was selected as a participant. This report summarizes our involvement in the project.

Left: *The University of Calgary Portable Methane Leak Observatory (PoMELO) conducting emissions surveys. The system is mounted on the roof of conventional field truck and is completely computerized.*

The PoMELO system is mounted on the roof of a conventional field truck and driven around emitting equipment. Detections of emissions, an estimate of the location and emissions rate are produced onboard immediately to facilitate follow-up actions such as additional Optical Gas Imaging (OGI) surveys or on-the-spot repairs.

The objectives of the deployment were to participate within the AMFC series of experiments, providing a reliable representation of the role of the PoMELO set of vehicle-based technologies. We also used the data from the deployment to advance the development of our technology.

The University of Calgary is a public research institution in Calgary, Alberta, Canada. The challenge of reducing methane emissions from the upstream oil and gas sector is well suited to the University expertise, mixing a need for deep scientific knowledge of atmospheric dynamics, measurement systems, and complex engineering. The PoMELO set of technologies is a research and development project - but is presently undergoing pre-commercial development to enable broader uptake and deployment in a commercial capacity.

Technology description

The PoMELO system is vehicle-based emissions measurement system. The system consists of a high-performance methane sensor, GPS positioning sensor, and anemometer mounted on the roof of a conventional field truck. The instruments feed data into a computer that runs customized software for detecting methane emissions, localizing the equipment that is emitting, and providing rapid quantifications of the emissions. We focus on providing immediate information, with no offsite post-processing required: anomalies of interest can be addressed while still onsite.

The basic principle of operation is as follows. As methane is emitted from vents, fugitives, and combustion sources, it is mixed and translated laterally by the ambient wind, forming a plume. We drive through the plume with our instruments and the system creates a detailed picture of the plume and most

likely source location. Over several passes through the plume, the information is refined and improved internally by the statistical model.

There are several use cases of the instrument and software package. First, plumes from emissions from individual equipment can be measured by driving around the pad. This provides data at the equipment scale. Second, plumes from the total site emissions (mixing vents, combustion emissions, and fugitives) can be measured to provide a total site emissions estimate. For the AMFC, we used the on-pad method due to the project focus on equipment-scale results and atmospheric instability throughout the fieldwork which favoured closer range work.

The PoMELO system is significantly different from previous incarnations of the instrumented vehicle concept. First, we measure and process data at a significantly faster rate than other systems. Processed data are fed into quantification and localization algorithms at 10 Hz. Second, the system is portable and streamlined with only select instruments to improve reliability. Third, the data are used with context to detect, localize, and quantify sources real-time. For example, an evolving picture of leak source locations is produced live while driving. This software is the primary contribution of the PoMELO system, it enables immediate reporting of information that is actionable by workers while onsite. The goal is to eliminate second, follow-up visits after the initial survey, reducing costs, increasing safety, and reducing emissions.

Data collection methods

For the AMFC set of experiments we used PoMELO primarily for on-pad work. We collected data in two phases:

1) We arrived at a site and initiated emissions data collection with our system. Within several minutes we had obtained a picture of the most likely emissions sources at the equipment level. From this, we labeled the sources with the equipment that was present and the system calculated emissions rates on a per-equipment basis. From this, an initial report was auto-generated and anomalous sources could be examined further with the OGI camera.

2) We also collected additional data at each site to help the project and facilitate our own technology development. We used a rapid-survey protocol to record the locations of key emitting infrastructure and recorded additional detail at sites about infrastructure present. These data will be used for our own internal technology development in a confidential manner - but are also available to the AMFC science team by request.

Results were generally finalized for most sites onsite, or during the drive to next site. We then transcribed our default report into the AMFC-specific reporting spreadsheets. AMFC-specific reporting required additional post-processing following the survey. We also created diagram sketch maps of the infrastructure present at each site to help understand the emissions from different types of equipment and accurately match our equipment-scale results with that of the other teams – whom measure emissions at a variety of other scales.

Fieldwork

We attended the full project tour from 10-21 June 2019. We conducted 101 site visits over 11 days in the field. We encountered no significant down-time due to equipment problems. We were limited in road access during some severe rain events and were forced to stand-down due to severe thunderstorms in several instances (following our internal health and safety protocols). Please note that the experiment did not

provide accurate data on survey speed as site access was limited by available permits and we were collecting additional data beyond the standard on-pad emissions data that would typify normal operations.

Learnings

The AMFC experiment allowed us a valuable opportunity to understand the types of emissions present on oil and gas sites and enhance our algorithms. We better understood the role of vehicle-based systems to address emissions challenges in the upstream oil and gas sector.

Areas for improvement

We generated additional data to help our site suitability modeling efforts. Vehicle-based systems are best suited for sites with good road access. With extreme rainfall and thunderstorms during the survey, we encountered the limitations of vehicle access. Some sites could not be visited due to unsafe road conditions. These conditions favour aerial systems that do not require road access – but these conditions can generally be predicted. In future surveys we are hoping to better predict when conditions are unsuitable, saving considerable cost in the process, and improving crew safety.

Cost implications

The AMFC fieldwork further emphasized the need for rapid results that are finalized onsite. The ability to generate actionable emissions data while still onsite facilitates follow-up with OGI cameras or immediate repair. This is advantageous as driving to site dominated fieldwork time (and cost). We believe this approach and the sophisticated software that enables it to be a strong advantage as the cost of follow-up visits with OGI crews is often not explicitly accounted for in cost-benefit studies of alternative emissions measurement technologies – yet is a major component of any emissions measurement program.

Additionally, our focus on sophisticated software that produced results immediately also minimized post-processing. This significantly reduces cost as personnel do not require dedicated time blocked post-survey, and clients are not left waiting for results while emissions continue. This study was an exception as it required more post-processing to generate specific data elements that our system does not produce onsite – necessitating some office work after the survey. However, the approach of immediate results was proven to provide tangible and valuable cost savings.

Data product example

The standard data product that is produced onsite is a template report that highlights emissions sources and emissions rates. Note that the user interface on computer in our vehicle can be also used to guide follow up work and can be zoomed to specific sources and queried to produce more detailed data. Our onsite report is designed for those whom wish to see a tangible report immediately. The report generation tool is known as ‘padmapper’.

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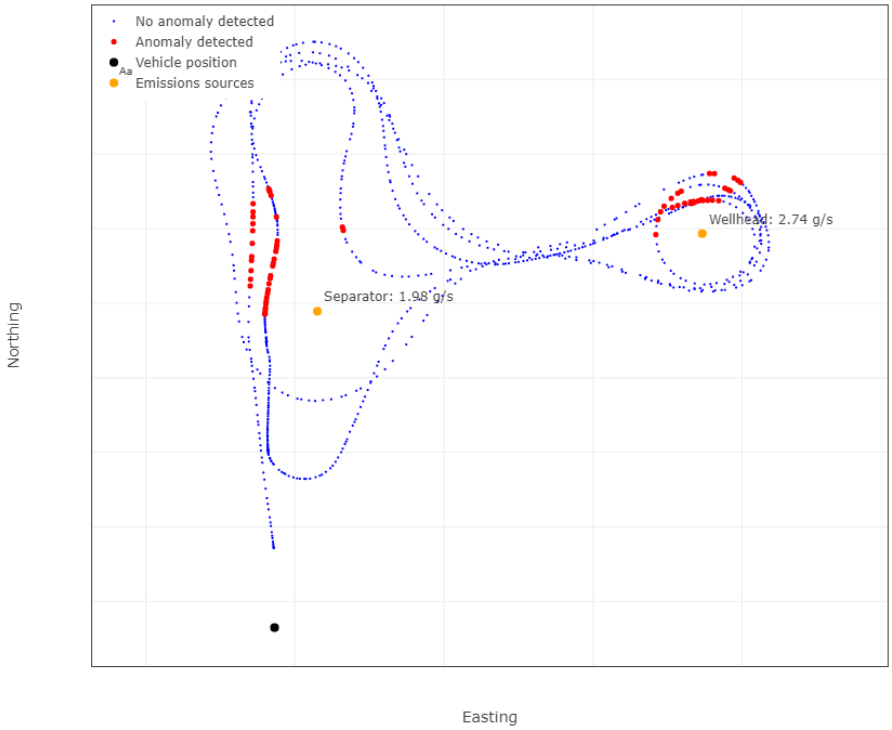
Padmapper Results

AMFC Site XX

Visit times: 2019-06-XX XX:XX - 2019-06-XX XX:XX

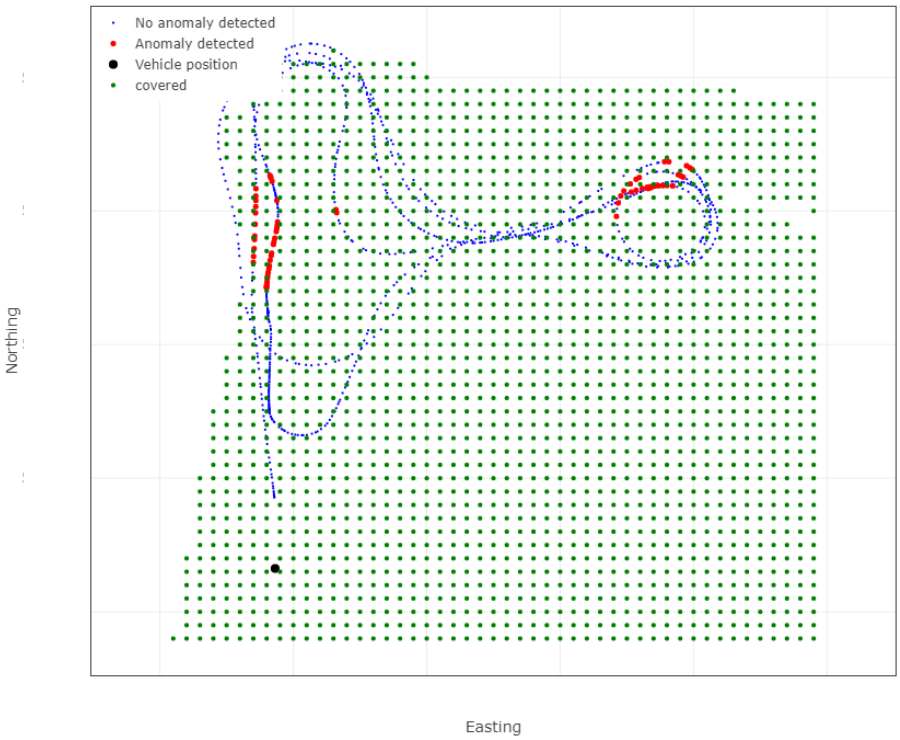
Padmapper Sources

Emissions sources: Map shows emissions sources on the site, with emissions rates in g/s.



Padmapper Coverage

Coverage: Map shows portions of the site that were surveyed with the system. Blue dots show where vehicle traveled, and no anomaly was detected. Red dots show where an anomaly was detected. Green dots show the region which was covered by the Padmapper system.



Source	Leak rate (g/s)	Easting (UTM)	Northing (UTM)
Separator	1.98	XX	XX
Wellhead	2.74	XX	XX

Report generated: 2019-06-XX XX:XX

Summary

The AMFC set of surveys provided valuable opportunity for our team to further mature and test the capabilities of the PoMELO vehicle system. A focus on rapid results delivery demonstrated proven value to accelerate the end-to-end workflow from initial survey to the actionable instructions such as leak tags or concrete emissions rate estimates.