Project Profile

Project Name:	Assessing the use of Unmanned Aerial Vehicles (UAV) to monitor oil and gas activities—specifically fugitive gas emissions and land disturbance/reclamation
Project Number:	HS-2018-01
Proponent:	University of British Columbia, Okanagan Campus (School of Engineering) Dr. Dwayne Tannant
Funding Envelope:	Health and Safety
Timeframe:	May 1, 2017 to January 31, 2019

Project objectives

The objectives of the project are as follows:

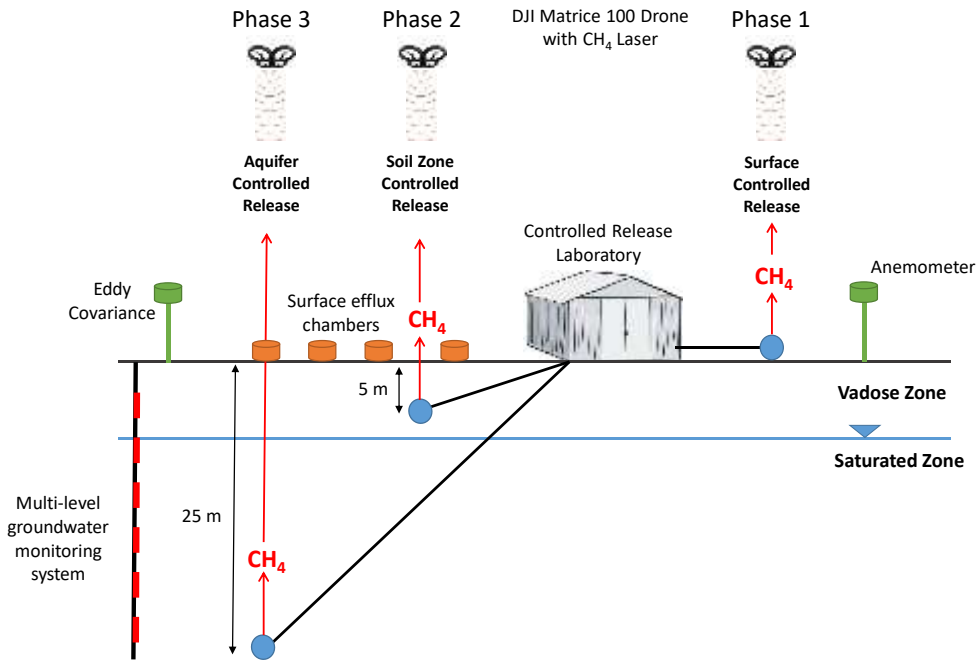
- Determine the capabilities and limitations of a moderately priced commercial drone and methane sensor—including optimal altitude of operation, range, flight times, sensitivity and efficacy of methodology;
- Assess the influence of field conditions on UAV-based methane measurements and to link to drone measurements to other parameters measured on the ground —including wind speed and direction, temperature, barometric pressure, etc.;
- Assess the potential for use of a UAV to detect shadow and deeper subsurface gas migration and efflux at surface; and
- Assess the potential for use of a UAV in quantifying land disturbance and reclamation activities under nature field conditions.

Project description

The projects aim is to evaluate the use of drones or UAVs to assist with the monitoring of fugitive gas emissions and land restoration as current manual or 'on the ground' methods are time consuming, expensive and inefficient.

The research will assess the potential for drone use in measuring fugitive gas emissions by characterizing basic detection capabilities and limitations in a series of controlled gas release experiments. The key concept of our proposed research is to release natural gas under various configurations in a controlled manner during which drone capabilities and limitations will be assessed. During these releases, a multidisciplinary monitoring network will be in operation, which characterizes atmospheric, soil and subsurface conditions allowing drone measurements to be better understood. Additionally we will perform various test flights over decommissioned well pads on crown land in the Hudson's Hope area to assess use of UAV's for land disturbance and restoration evaluation.

A UAV supplied by Vector Geomatics Land Surveying Ltd. from Fort St John will be equipped with a Laser Methane mini LMm-G methane detector. The Advanced Control and Intelligent Systems Lab at the School of Engineering will provide software and hardware to enable the methane measurement readings to be synchronized with a 3rd party GPS carried by the drone. A DJI Phantom 4 Pro drone will be used to acquire photos to document the experiment and to construct high-resolution digital terrain models of the test site and orthophotos.



Project approach

The project involves the following four phases:

1. **Surface Natural Gas Leakage Test (Summer/Fall 2017)**: Initially a series of controlled surface (i.e. at ground level) natural gas releases will be performed in varying configurations (i.e. rates of release, height of drone, and drone speed, etc.). Simultaneously atmospheric conditions, ground-based methane detectors, and eddy covariance of methane will be monitored. This will allow limitations and capabilities of UAV measurements to be assessed and influence of atmospheric processes on the UAV's measurements to be evaluated.
2. **Soil Zone Leakage Test (Fall 2017)**: A sub-surface natural gas release (at ~12 m depth) will be conducted into the unsaturated soil zone. Here soil gas (analyzed by GC), surface efflux (taken using flux chambers) and eddy covariance/atmospheric conditions will be monitored and UAV methane laser measurements employed simultaneously.
3. **Shallow Aquifer Leakage Test (Spring through Summer 2018)**: Building on the surface and soil zone controlled gas releases, the methane sensor fitted UAV will be employed at several discrete times during the HH FGRS multidisciplinary main release experiment. During the main

test approximately 300 m3 of natural gas will be injected at 25 m depth into the shallow aquifer system over 6 months. Here migration through the sub-surface and to atmosphere will be monitored at a high spatio-temporal resolution. The methane UAV will be employed for several flights days during this experiment when surface efflux is identified, characterized and quantified. These test flights will allow subsurface migration and use of UAV's in its detection to be assessed. The drone monitoring results will be linked and validated with more precise ground based measurements.

4. **Land Disturbance/Reclamation Test Flights (Summer 2018)**: We also wish to take advantage of the personnel and drone equipment that will be in the field for the methane detection project to also test and evaluate the capabilities of a drone for measuring and assessing the state of reclamation on nearby well pads and/or pipeline corridors. In the summer of 2018, we plan to include multispectral imagery in addition to a standard RGB camera.

Project deliverables

The deliverables from this project include the following four technical reports:

1. Assessment of UAV potential for detecting fugitive gas emissions at surface.
2. Assessment UAVs for characterization of land disturbance/reclamation.
3. Assessment of UAV potential for detecting subsurface fugitive gas release and gas migration.
4. Assessment of wider spectral range imagery for characterization of land disturbance/reclamation.