Final Report 2016-2018

Contract Information

Title	Baseline measurements of methane emissions from Piedmond Lake - current and future fracking area
Project Number	G16AP00076
Start Date	3/1/2016
End Date	2/28/2018 (including a 12 Month no-cost extension)
Lead Institute	The Ohio State University
Principal Investigators	Gil Bohrer

Abstract

Methane is the second most important green-house gas (GHG). Methane is emitted from natural wetlands ad lakes, and also from natural gas extraction and production operations. The large uncertainty surrounds both the quantity and mechanisms producing natural methane emissions from lakes and wetlands, and fugitive methane emissions during hydrofracking, compound in areas where fracking is conducted near and/or under lakes and wetlands. In such cases, there is a strong need for baseline observations of the natural emissions which will be used to distinguish those from additional emissions, if present, related to fracking.

The direct result of this project will be the development of a dataset of observations of baseline emissions from Piedmont Lake, OH, and an empirical model for the emission rates from the lake. Though the modelling approach is general and could be applied anywhere, we will use the depth of data at our field site in the 4H camp at the shore of Piedmont Lake, near future potential fracking sites. Some of the area around the lake was cleared for fracking activity, and production may start in the next few years.

Methodology

1) The establishment of an OSU fracking research site in Piedmont Lake by the USEEL center has failed and an OSU site will not exist. Our project was leveraging on that site, and therefore, we were forced to locate a flux tower with measurements of methane emissions.
2) A site to locate methane measurements was set up in partnership with Derrek Johnson in West Virginia University. A 20 m tall flux tower was located downwind a planned well pad locations near Morgantown West Virginia. The tower is relatively tall to allow a wide footprint area (Figure 1).
3) Ongoing measurements of meteorological conditions (air temperature, pressure and humidity, wind, precipitation and incoming radiation) and methane and CO2 fluxes using eddy-flux are conducted continuously at the West Virginia site since 7/2017 and will continue until 12/2018. The tower includes an LI7700 open path methane analyzer, and a closed path isotopic methane analyzer. This tower was funded by NSF.
4) A campaign for chamber measurements of the fluxes from the river near the tower and fracking site will start in May 2017 and be repeated monthly June-September 2018.
5) We used the EC measurements with a neural network modeling approach to model the baseline fluxes before the start of fracking activity. We will identify fracking related peaks as

peaks above the baseline after the start of fracking. Fracking-related peaks will also have an isotopic signature indicative of fossil methane source.

6) We will use a large eddy simulation model (PALM) to combine chamber and EC flux measurements to determine the potential source locations of emission peaks.

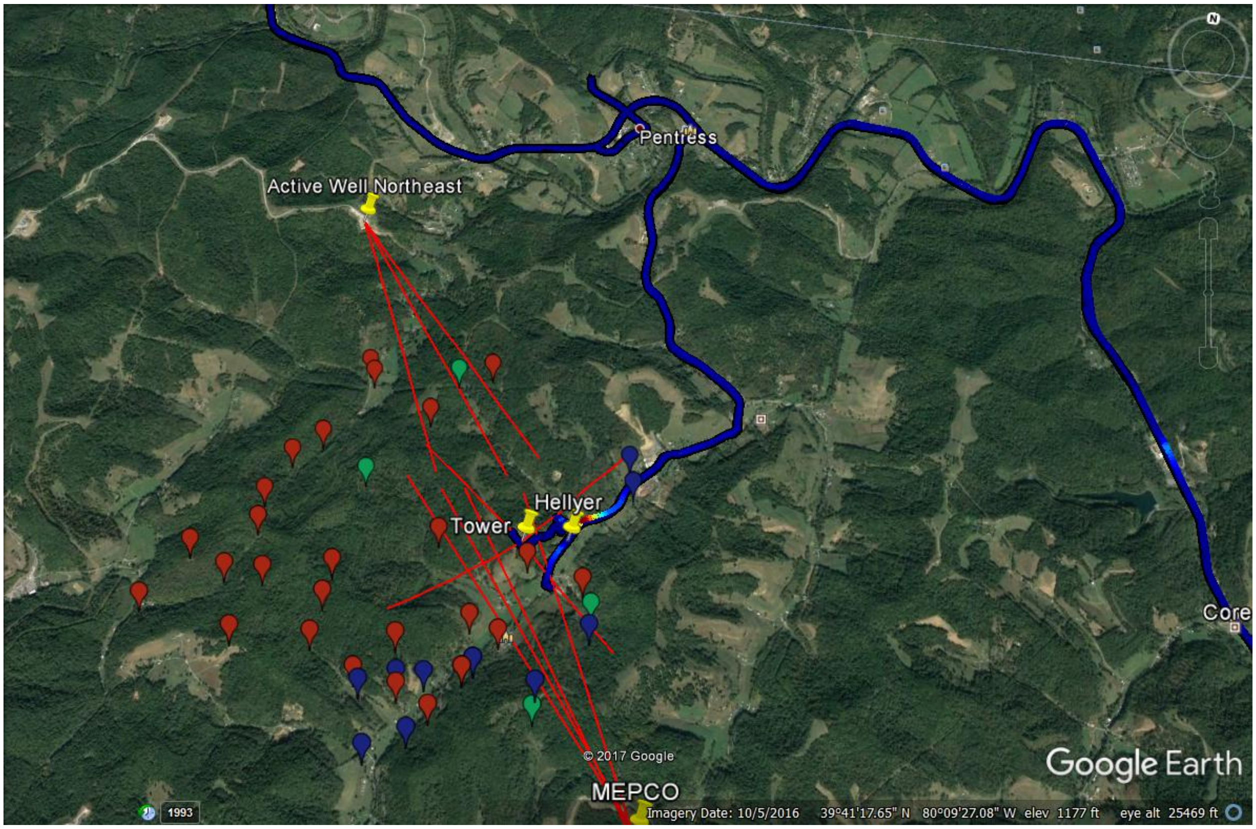

Figure 1. *A site for the flux tower was established in Pentrass WV. A 20 m tall flux tower was constructed and instrumented (yellow tack "Tower"). The closest active and planned fracking pads (yellow tack marks), planned horizontal fracking well paths (red lines), abandoned wells (blue markers), plugged wells (red markers), and active wells (green markers) are illustrated. A campaign for measurement of methane concentrations in the air using the West Virginia Mobile air quality lab was conducted in 5/2017. The mobile lab drove from WVU campus in Morgantown to our tower site, and around the county roads near or tower site. Methane concentrations are illustrated in color (blue - ambient, near 0 to red - high concentrations) along a thick line overlaying the mobile lab sampling path. We found clean (low methane consecrations) throughout the region, except when in proximity to some active wells.*

Major Activity

Unfortunately, the NETL project has failed to secure a study site and activities in the USEEL Will not be possible. Therefore, it was impossible for us to start our fieldwork at the planned project period. A 1-year no-cost extension for the project was requested and approved. We have secured an alternative field site in collaboration with Prof. Derek Johnson in West Virginia University. The site is near Morgantown WV, on private land, near a fracking pad (Fig 1). Fracking activity has started in December 2017, a few months after we started measuring the baseline emissions. This project provide an additional components of chamber measurements in a larger NSF-funded project that will fund the construction of a flux tower and the flux analysis activity. A subcontract from the NSF funding was signed with WVU and field work at the new site started in May 2017. The tower construction was completed and the site is fully operational and reporting data since July 2017. We have been coordinating the tower construction planning through teleconference with Derek Johnson in WVU. We have secured an agreement with the Olentangy River Wetland Research Center for access to the GCMS for analyzing the chamber observations and in the process of preparing the needed supplies for the chamber measurement campaign (sterilizing and evacuating vials).

Findings

A chamber measurement campaign took place in May 2017. We measured bassline methane fluxes from the field surrounding the tower, and from the near-by river. At each patch type (field, river) duplicate chamber measurements were taken at 3 locations. The grass field produces no methane, and some very low rate of methane oxidation occur in the soil. This is important for the interpretation of the measurements from the flux tower, as it indicates that observations will represent remote sources of methane and are not influenced by baseline emissions at the local field around the tower. As expected, some methane emission occurred from the river. Any wet ecosystem typically produces some methane. Nonetheless, the emissions from the river were very low. For example, they are about 2 orders of magnitude lower than emissions we typically observe in natural wetlands. The resulting fluxes we observed are illustrated in figure 2.

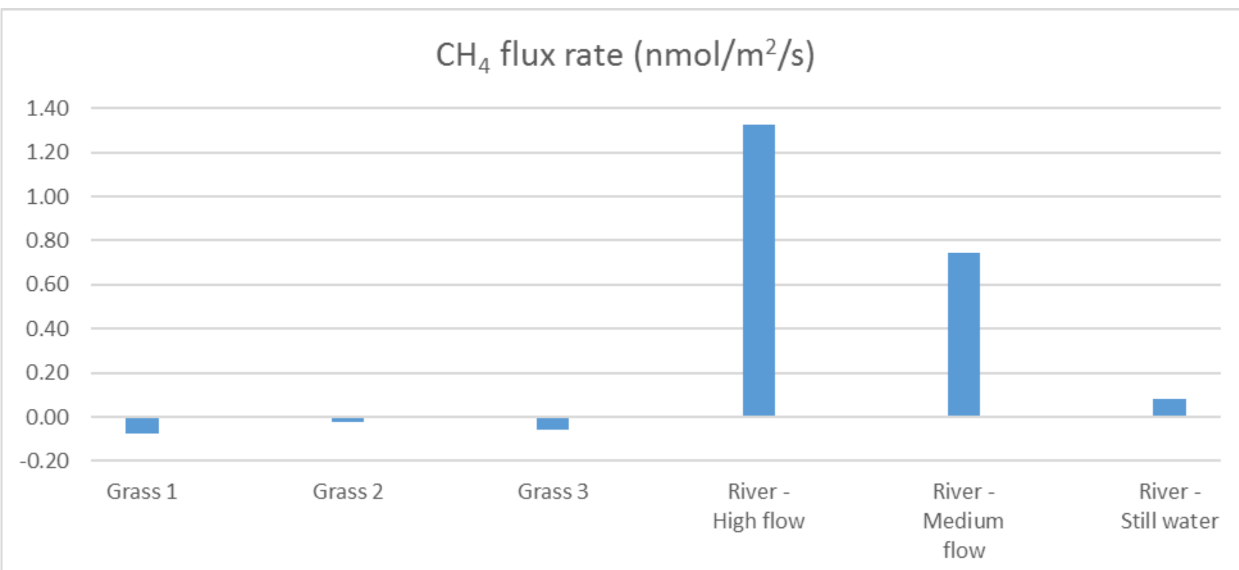

Figure 2. Methane fluxes from grass field and river near flux tower location and fracking site

An automated neural network (ANN) model of the methane concentration at the

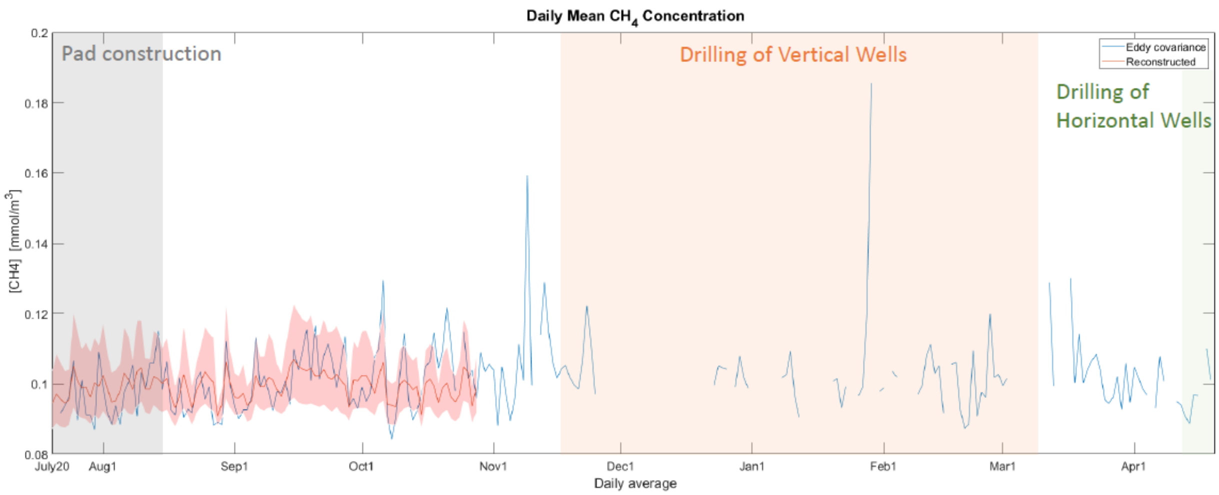

Figure 3. CH_4 concentration from WV site. Neural network model is used to estimate CH_4 concentration during baseline period (July 20- Oct 1, red line). Horizontal drilling is currently ongoing. 5% to 95% uncertainty levels of the ANN model are calculated and shown in red shading. Projecting the model forward to the drilling period will allow identifying above-baseline peaks.

Significance

The project will provide baseline measurements of methane emissions from natural and agricultural aquatic ecosystems around the proposed locations of a hydrofracking site. These observations will allow developing an empirical model for the natural methane emissions from the water system at the site and will allow determining whether these emissions increase due to diffused methane release into the ground water after the drilling operations started.