

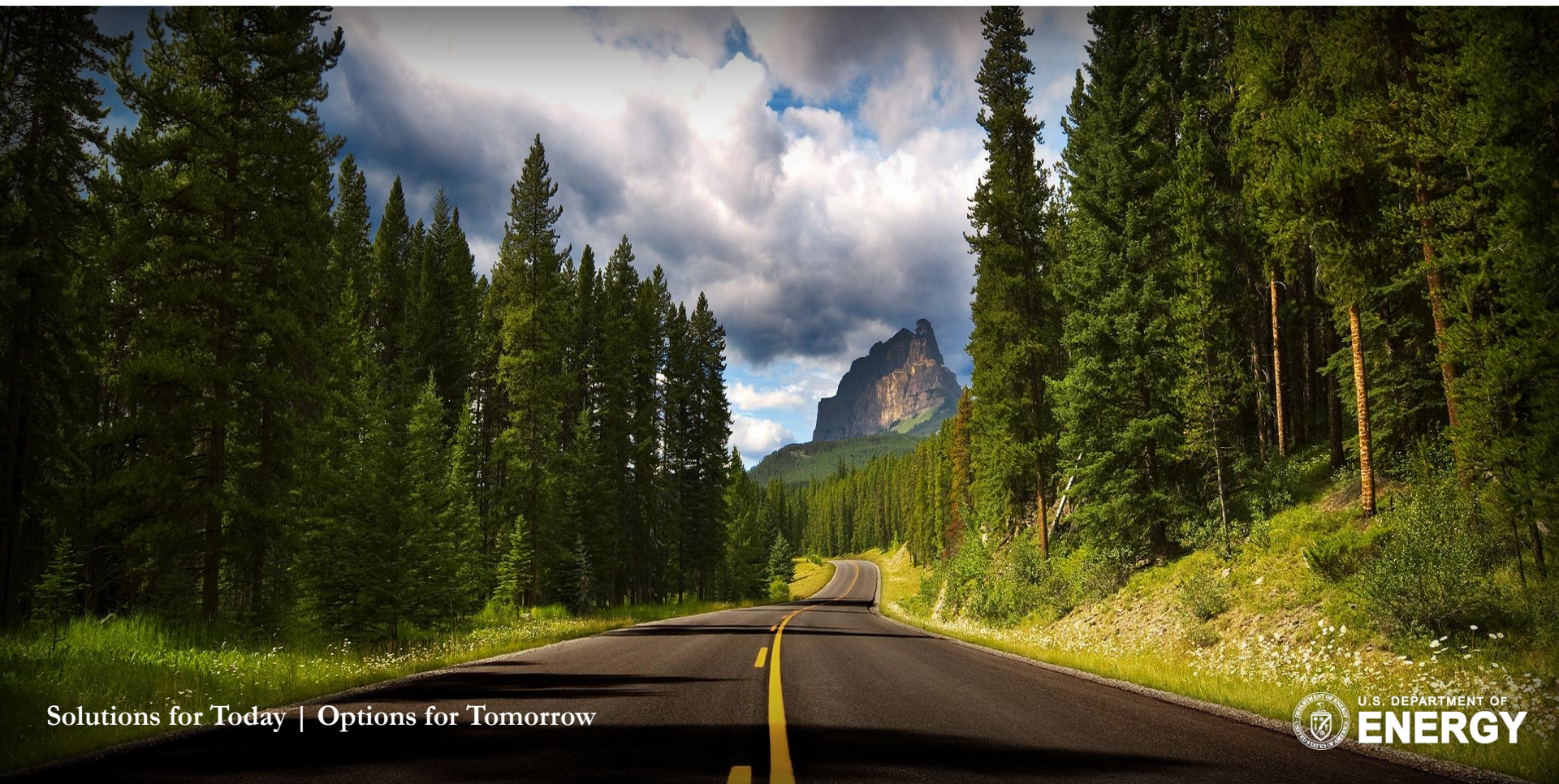
# NETL Research and Innovation Center's Methane Emissions Quantification Program



EPA Stakeholder Workshop on Natural Gas and Petroleum Systems  
in the GHG Inventory

June 22, 2017

Natalie Pekney, PhD, NETL



Solutions for Today | Options for Tomorrow



# NETL Research and Innovation Center's Methane Emissions Quantification Program

## • OBJECTIVE

- Emission quantification of natural gas infrastructure sufficient to update the EPA Greenhouse Gas Inventory (GHGI)

## • APPROACH

- Obtain a more detailed and comprehensive data set for selected components/facilities of the nation's natural gas midstream infrastructure.
- Field efforts concentrated on characterizing:
  - Gathering system pipelines
  - Abandoned and orphaned gas wells
  - Legacy gas pipelines

## • NETL'S PARTNERS & THEIR ROLES

- Industry & Universities: R&D and field validation partners
- National Labs: Partners in fundamental science R&D
- NGOs: Independent quantification efforts funded with universities (e.g., EDF)
- EPA: Identify GHGI needs and collaboration in field campaigns



# NETL Facilities/Capabilities



NETL's Mobile Air Monitoring Laboratory



SUV-based Methane Survey Results

- Source Emissions Measurements
- Tracer Release for Indirect Methane Emissions Measurements
- Vehicle-based Methane Surveys
- Ambient air monitoring



Hi Flow Sampler



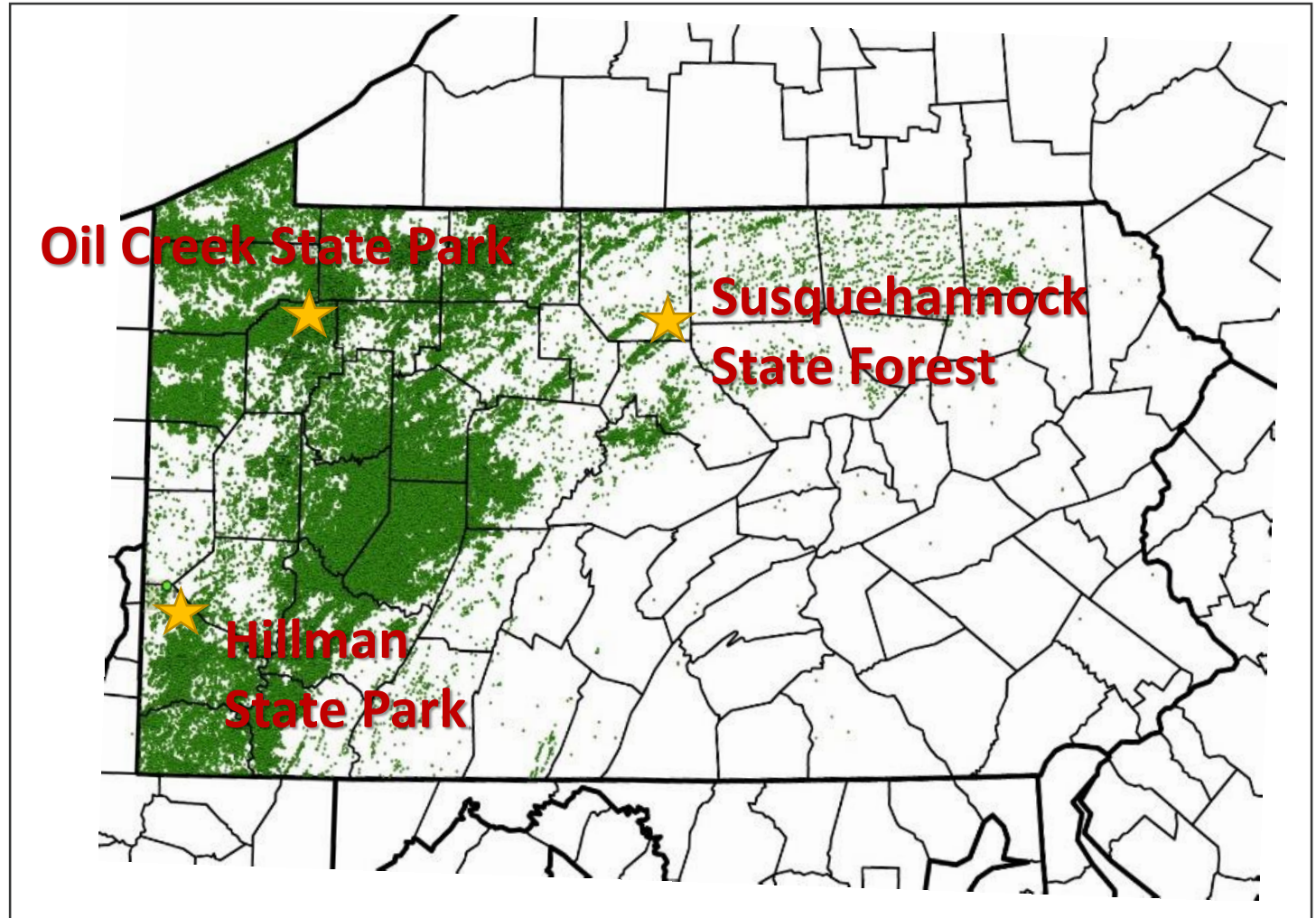
NETL's Utility Terrain Vehicle (UTV) equipped with methane detection instrumentation



Dynamic Flux Chamber Network (Eosense)

# Pennsylvania Abandoned Wells Field Study: Aerial Surveys and Ground-based Verification

Summer 2014



# Aerial Survey Instrumentation

Picarro G2203 Methane Analyzer

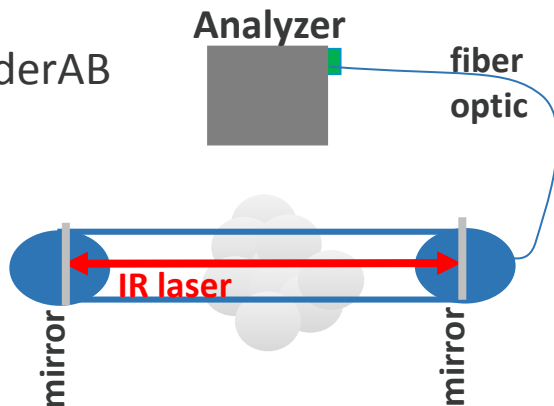


Scintrex Cesium Vapor  
Magnetometers

Ground-based Portable  
Meteorological Station

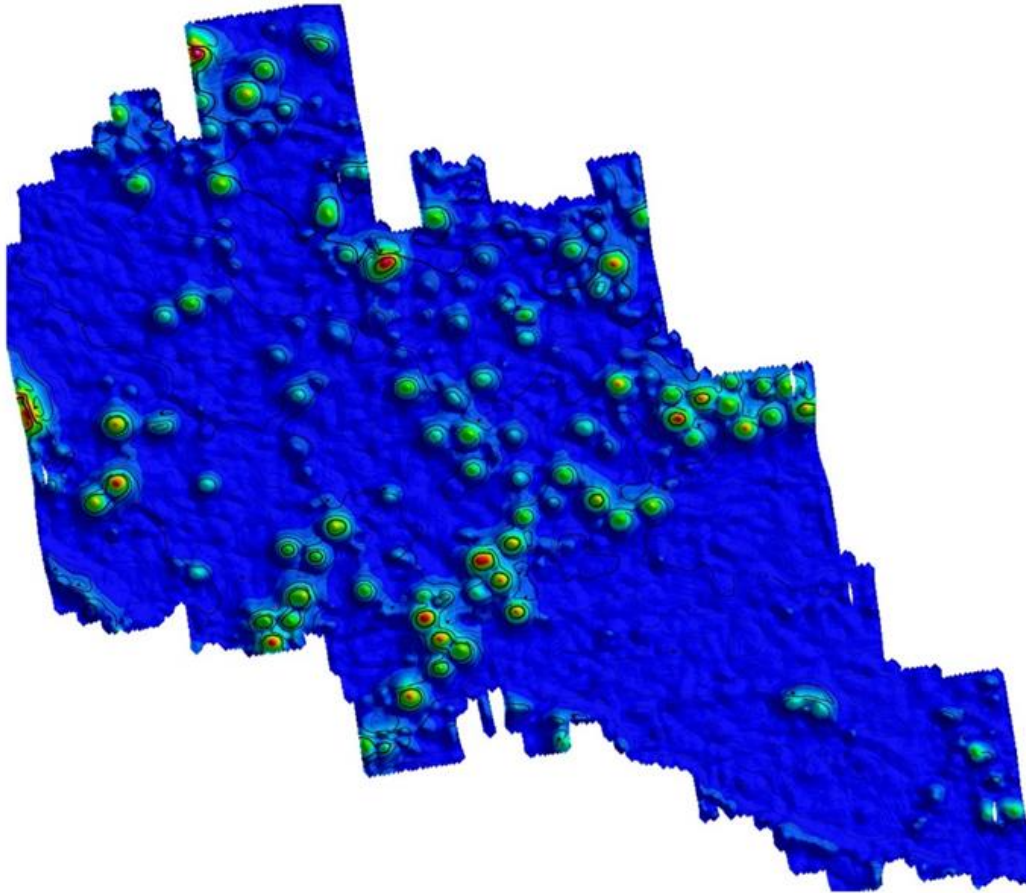


Boreal  
GasFinderAB

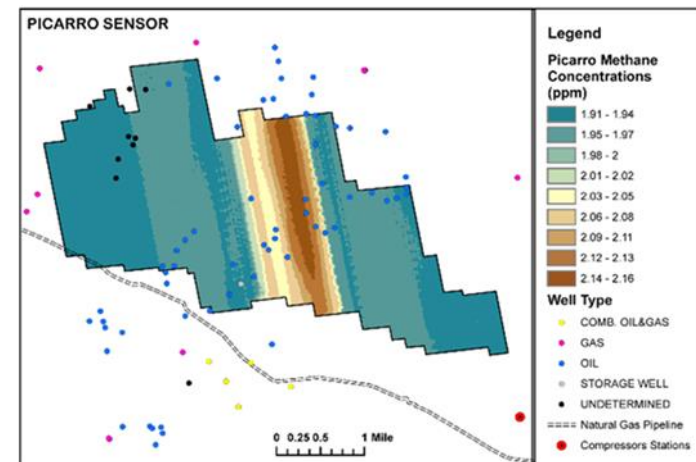
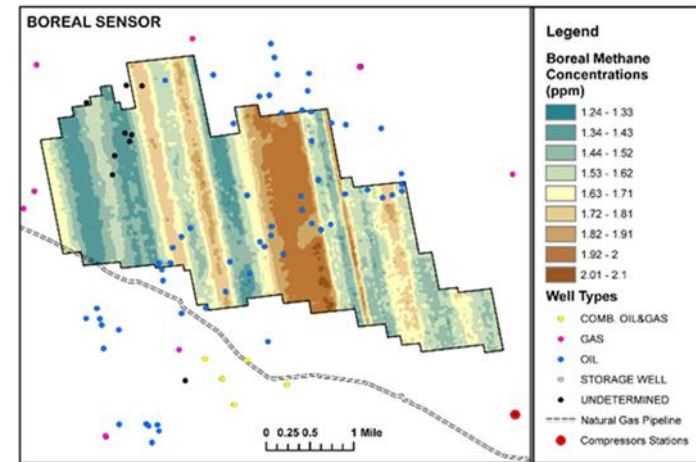


# Hillman State Park Aerial survey results

*Magnetic Data*

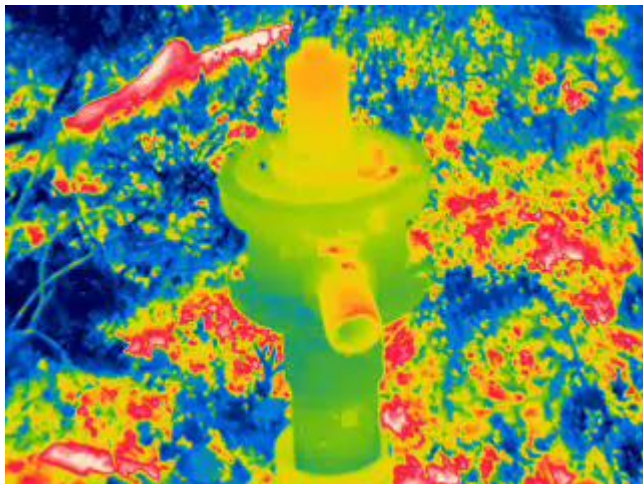


*Methane Data*



# Abandoned Wells Emissions Measurements: Hillman State Park, PA

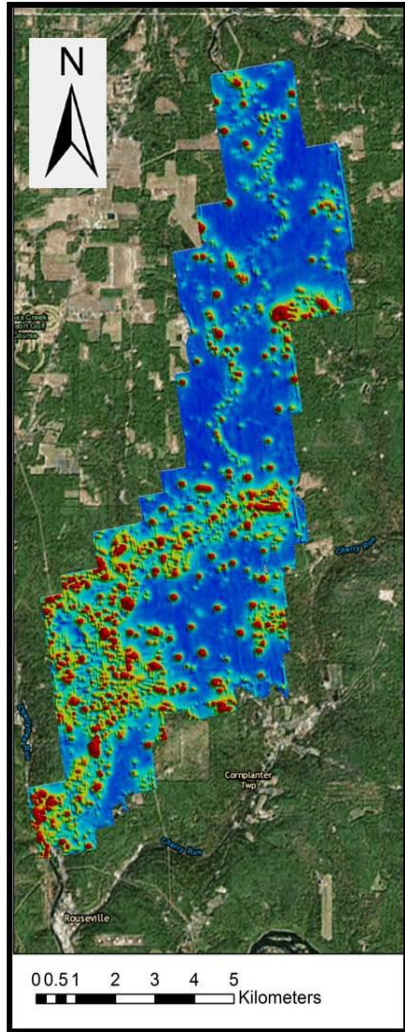
- 31 wells sampled
  - 22 above ground, unplugged; 9 buried
- Average emission rate 0.70 kg CH<sub>4</sub>/well/day for aboveground wells
- Methane soil flux for buried wells not significantly different than background



## *Comparison of measurement techniques*

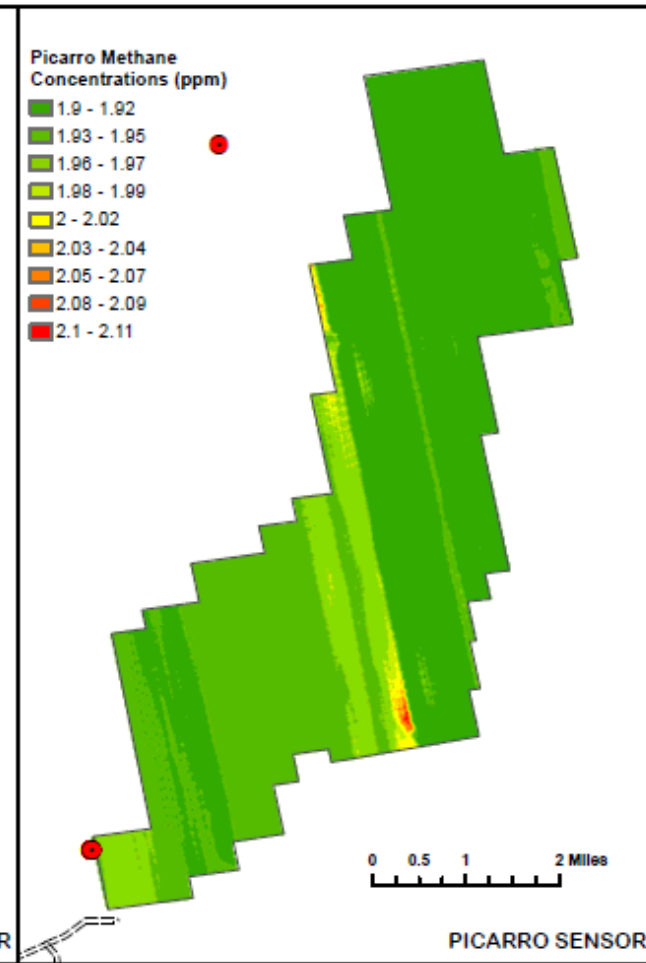
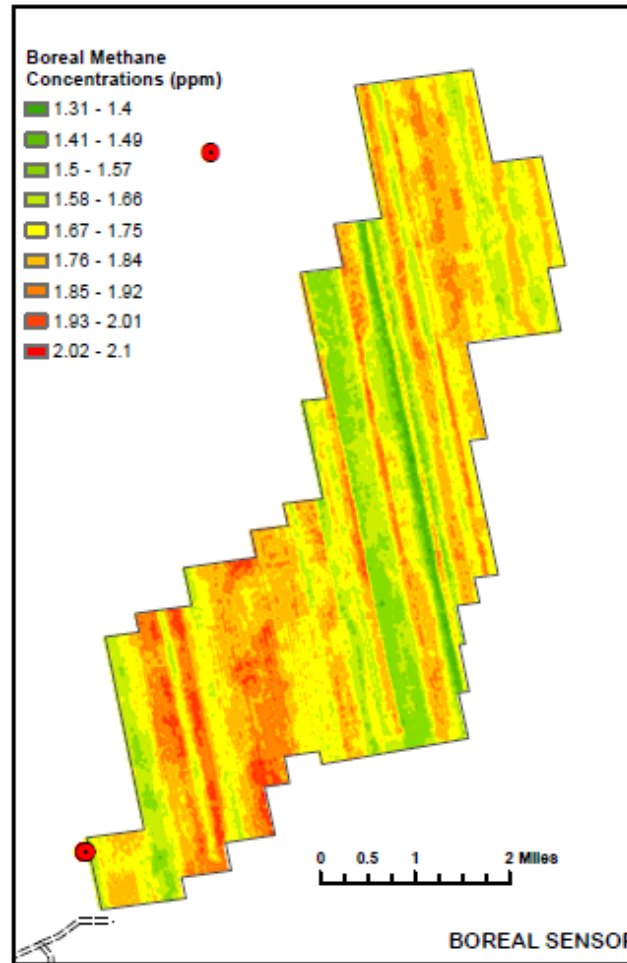
FID screening, Hi Flow sampler, bag sampling, dynamic flux chamber, infrared camera

# Oil Creek State Park Aerial survey results



*Magnetic Data*

*Methane Data*





# Abandoned Wells Emissions Measurements: Oil Creek State Park, PA

- Various data sources for well location
- 60 wells done as of June 7
  - At least 14 plugged
- 8 leakers, leak rate  $\leq 1.1$  lpm  $\text{CH}_4$
- Target 130 wells for 95% confidence of representative sample for the park area



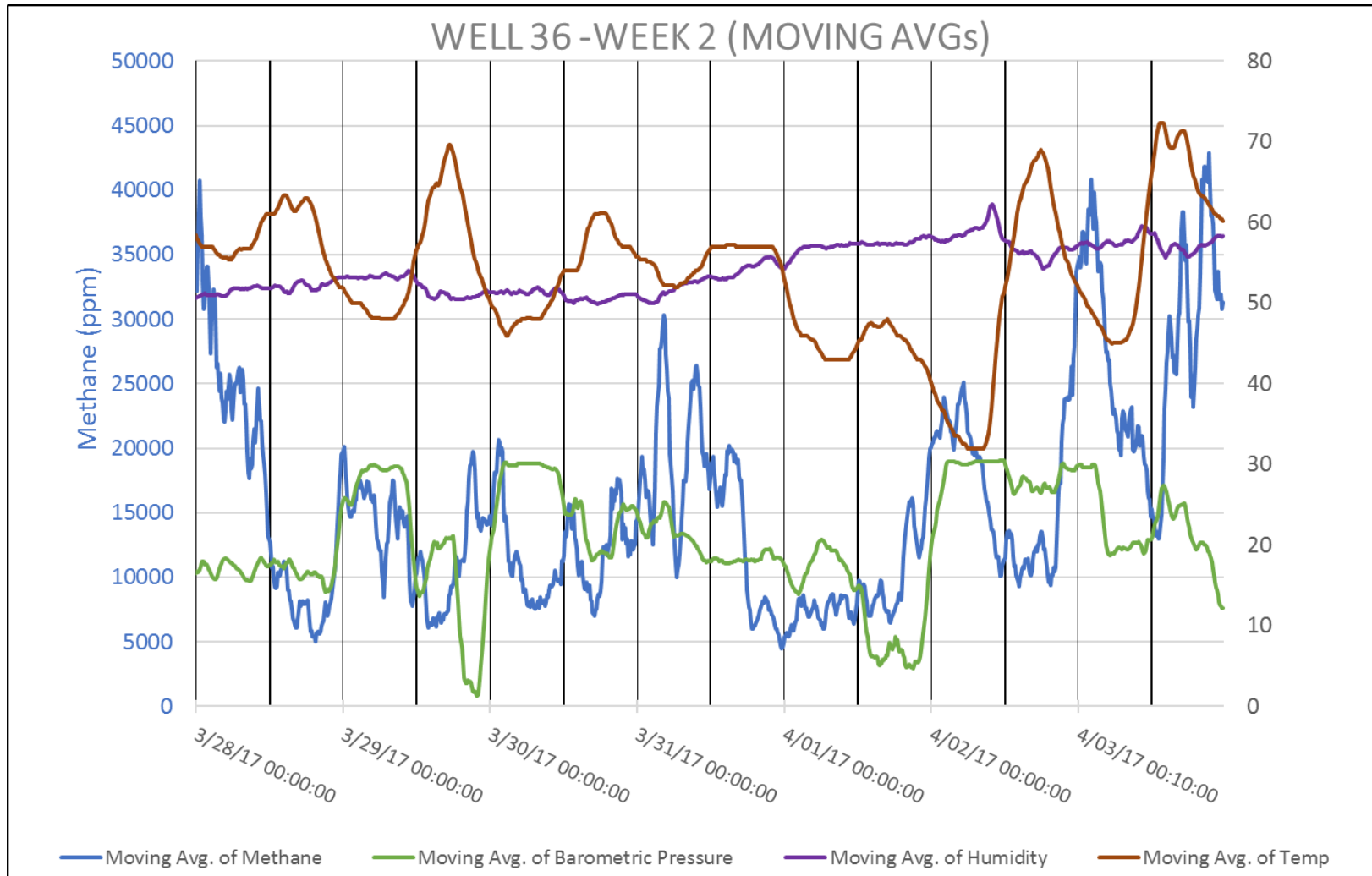
# Abandoned Wells Continuous Methane Emissions Monitoring

Pix Controller  
RemoteMonitor™  
CH<sub>4</sub>  
Real-time  
transmission over  
wireless data  
connection  
0-100% LEL CH<sub>4</sub>  
detection with 100  
ppm resolution



*Sensors installed at two abandoned wells in Hillman State Park*

# Abandoned Wells Continuous Methane Emissions Monitoring



# NETL RIC's Abandoned Wells Field Measurements Summary

- **Hillman State Park results journal article submitted for publication**
- **Continuous monitoring ongoing**
  - Draft report planned end of FY2017
- **Oil Creek State Park study ongoing**
  - Data mining for information about age, production, date of abandonment/plugging, etc.
  - Draft report planned end of FY2017

# Leak Rate Estimation for Natural Gas Gathering Pipelines

- Estimation for gathering pipelines vs. transmission/distribution
- Measurement approaches: methods development
- Field survey challenges



# Susquehannock and Moshannon State Forests Ground-based Surveys

## Susquehannock



*Leak rate quantified: Blow-down valve*

Equipment	Function
Boreal Laser	Methane Analyzer
Anemometer	Meteorology
GPS	Location
Multiplexer	Data Coding
FLIR	Methane Imaging
PMD	Methane detector
VMD	Optical Methane Detector
SPAR300	Utility Locator

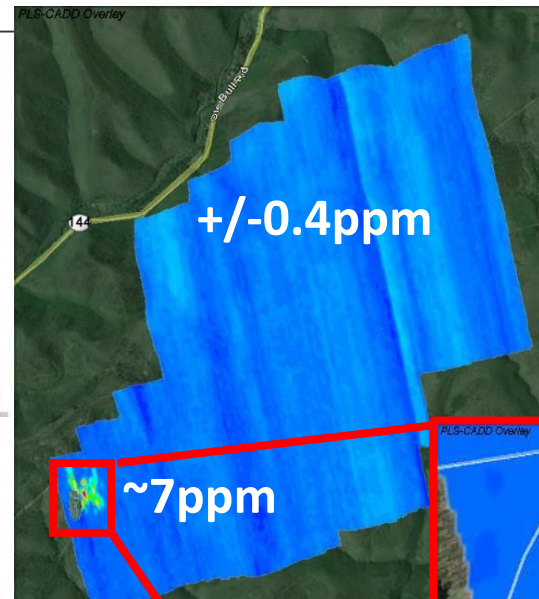
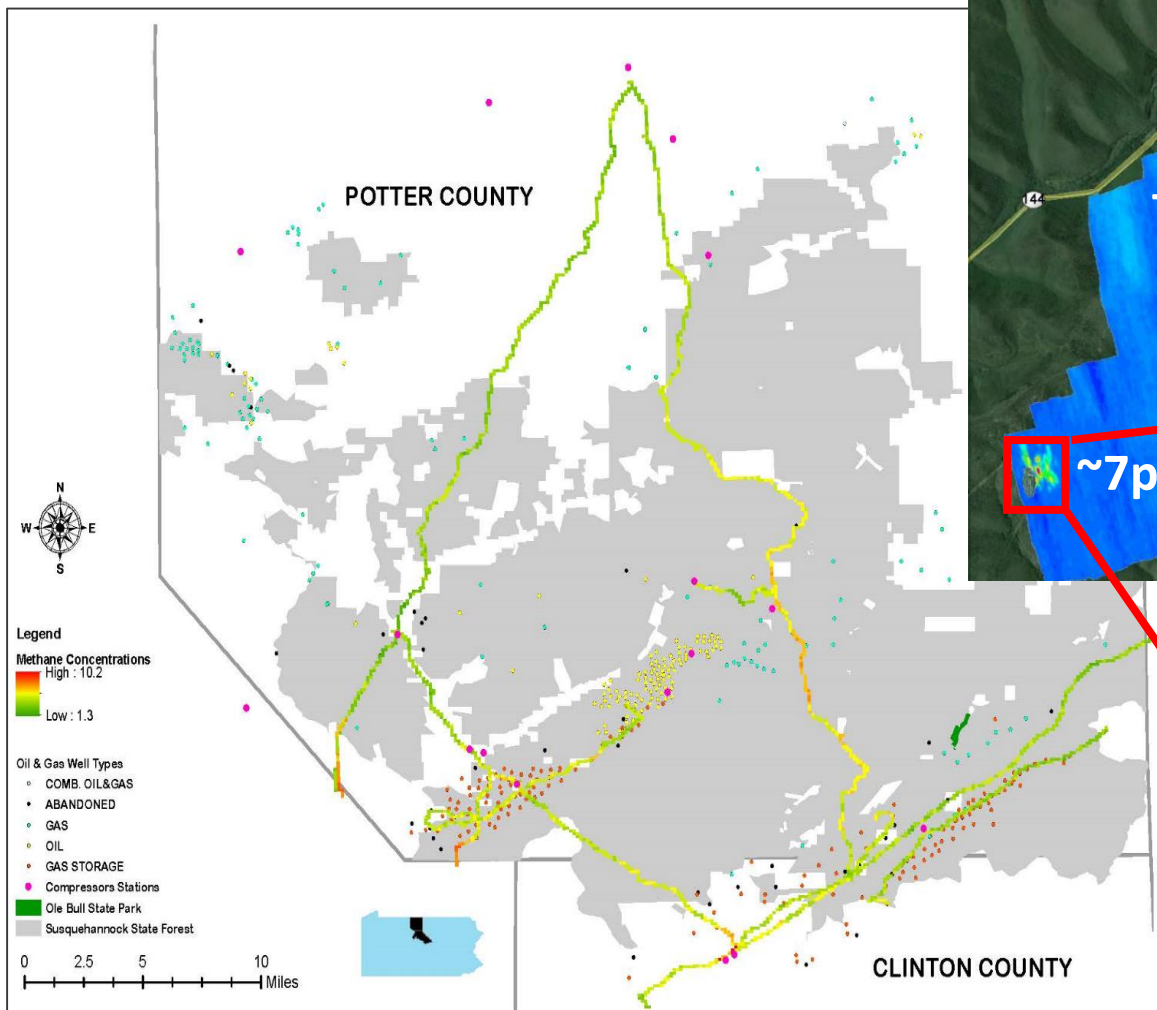
## Moshannon



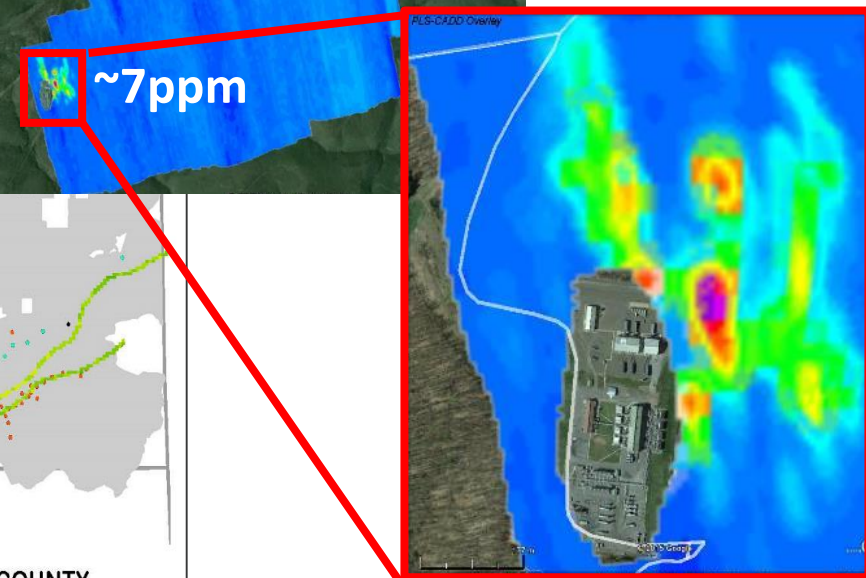
*Controlled CH<sub>4</sub> release*



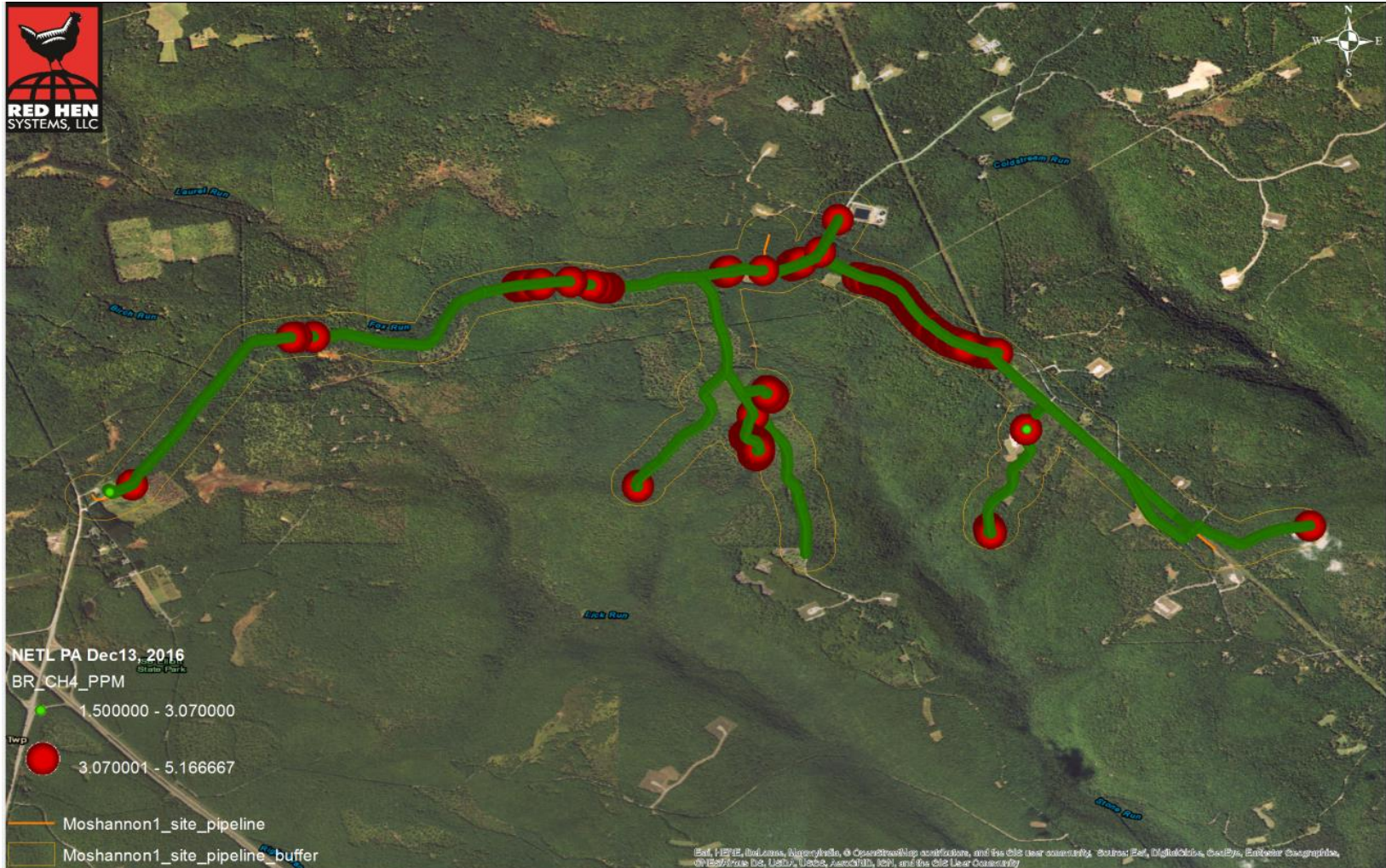
# Susquehannock State Forest Aerial Survey Results



Aerial Detection of Methane from a Compressor Station:



# Moshannon State Forest Ground-based Survey Results





# Gathering Pipeline Leak Rate Estimation Challenges and Lessons Learned

- **Proximal methane sources**
  - Includes natural sources (e.g. geological seepage)
- **Variables**
  - Leak Rate
  - Wind speed and direction
  - Sensor Altitude
  - Sample rate
  - Barometric pressure? Humidity?
- **Top-down surveying requires highly sensitive detectors; low-level leaks not detected at high altitudes**
  - Ground-based follow up necessary for aerial surveys
- **High sampling rate required**
- **Single vs. multiple passes: lower cost vs. increased probability of plume interception**
- **Cooperation with pipeline operators is helpful**
- **Looking forward: UAV-based surveys**
  - Miniaturized magnetometer for (metallic) pipeline finding
  - Pergam LMC sensor for methane detection (ppm-m)

