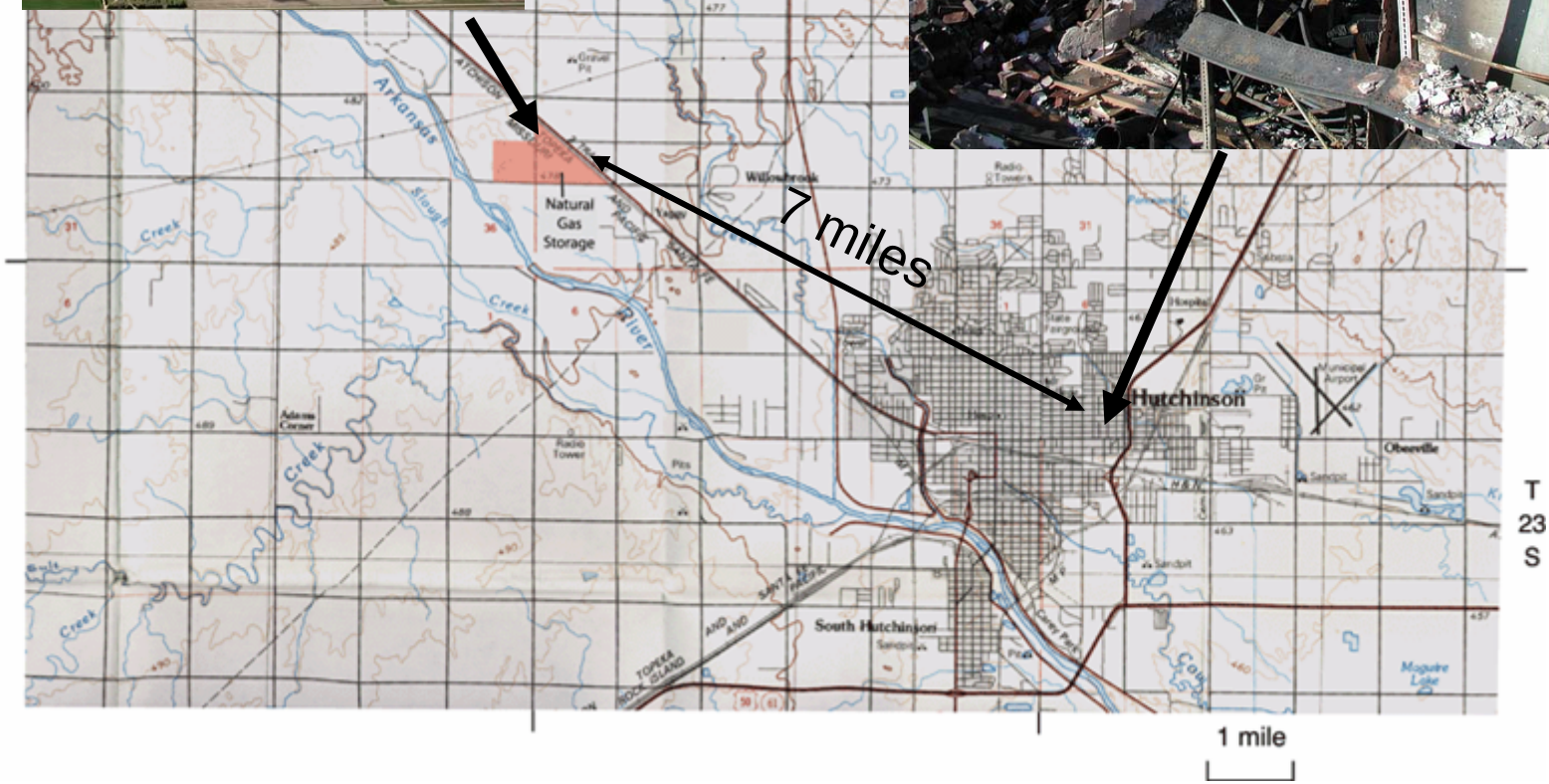
Well Detection

A field trial of well detection strategies

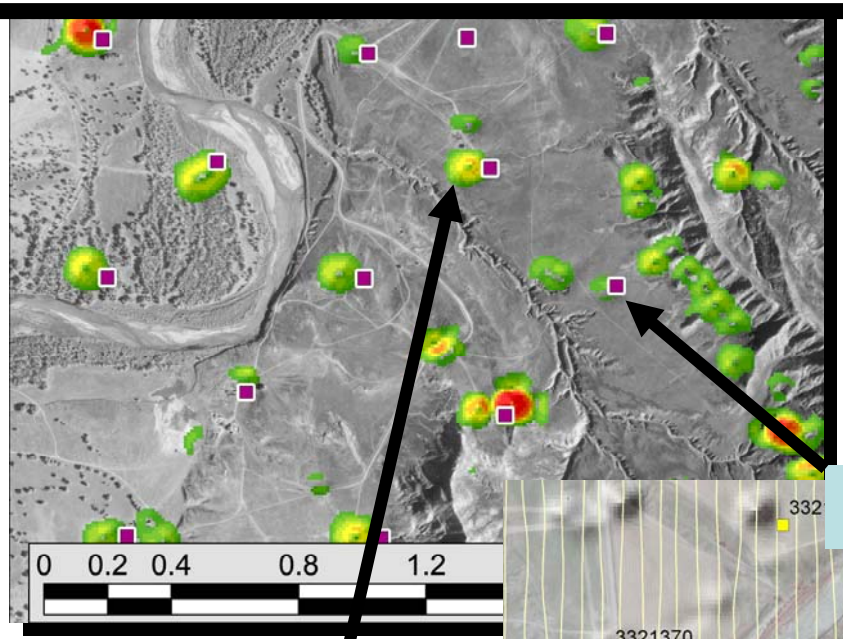
Salt Creek Oilfield, Natrona County, Wyoming

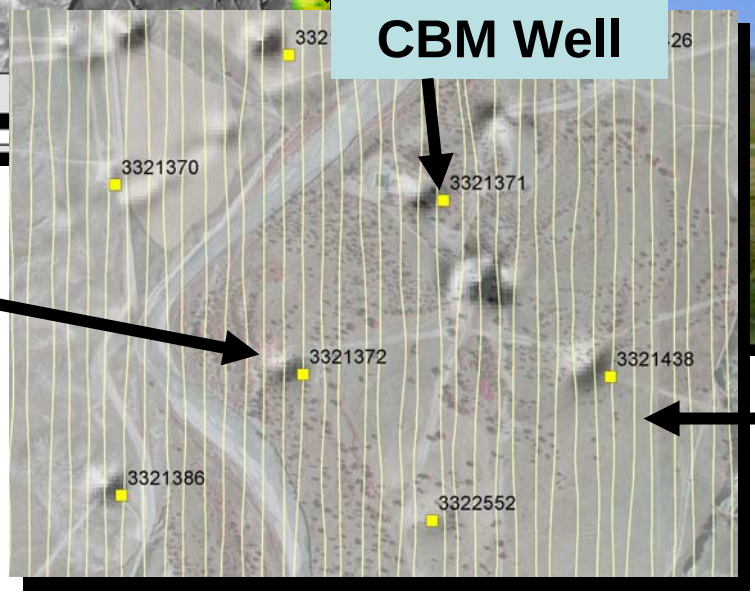
http://www.geotimes.org/oct01/feature_kansas.html

Natural Gas Storage Field



Helicopter Magnetic Surveys to Detect Steel-Cased Wells





CBM Well

Airborne Magnetic Signature

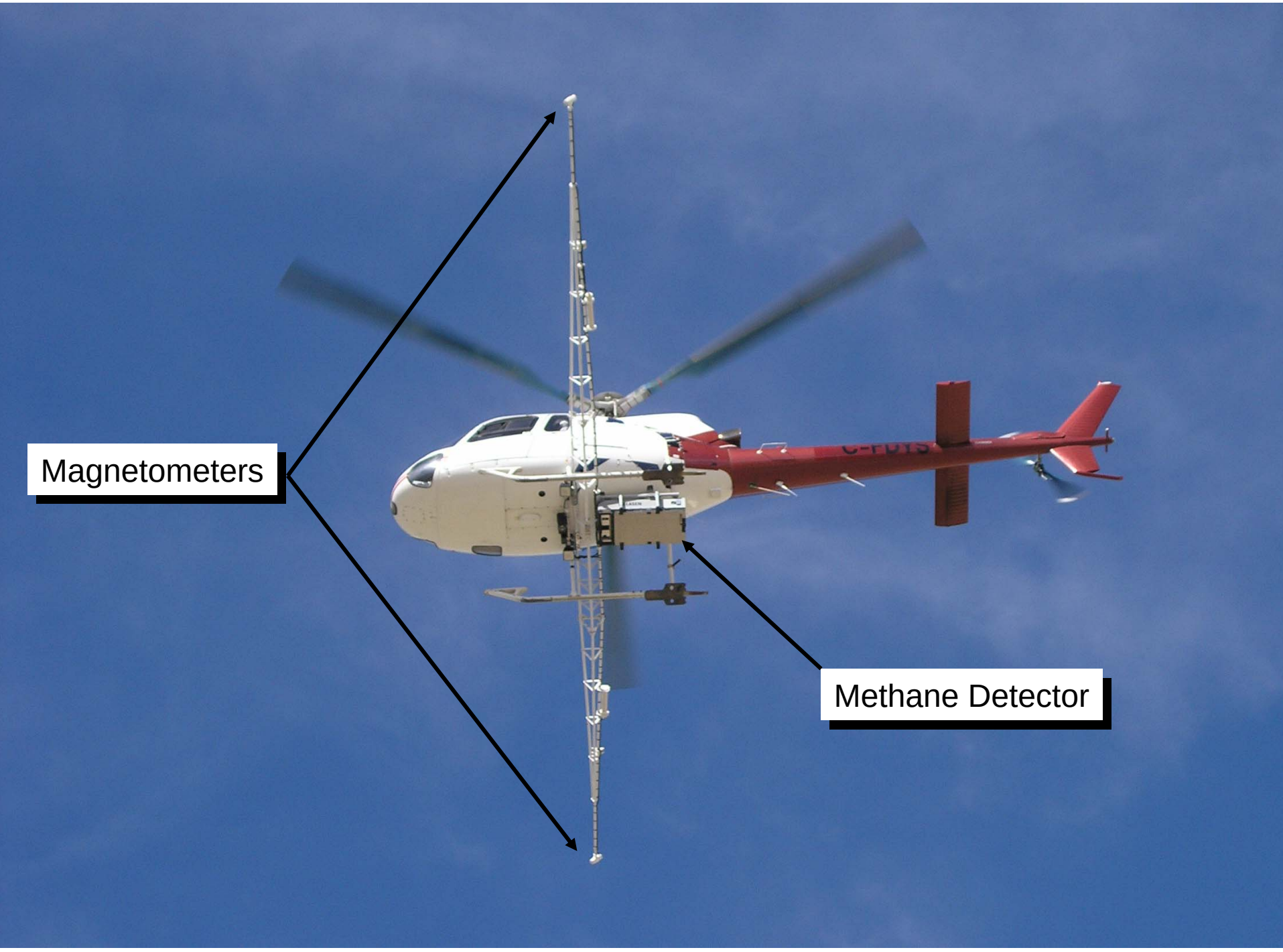
Flight Lines

GMC

Well Detection Strategy

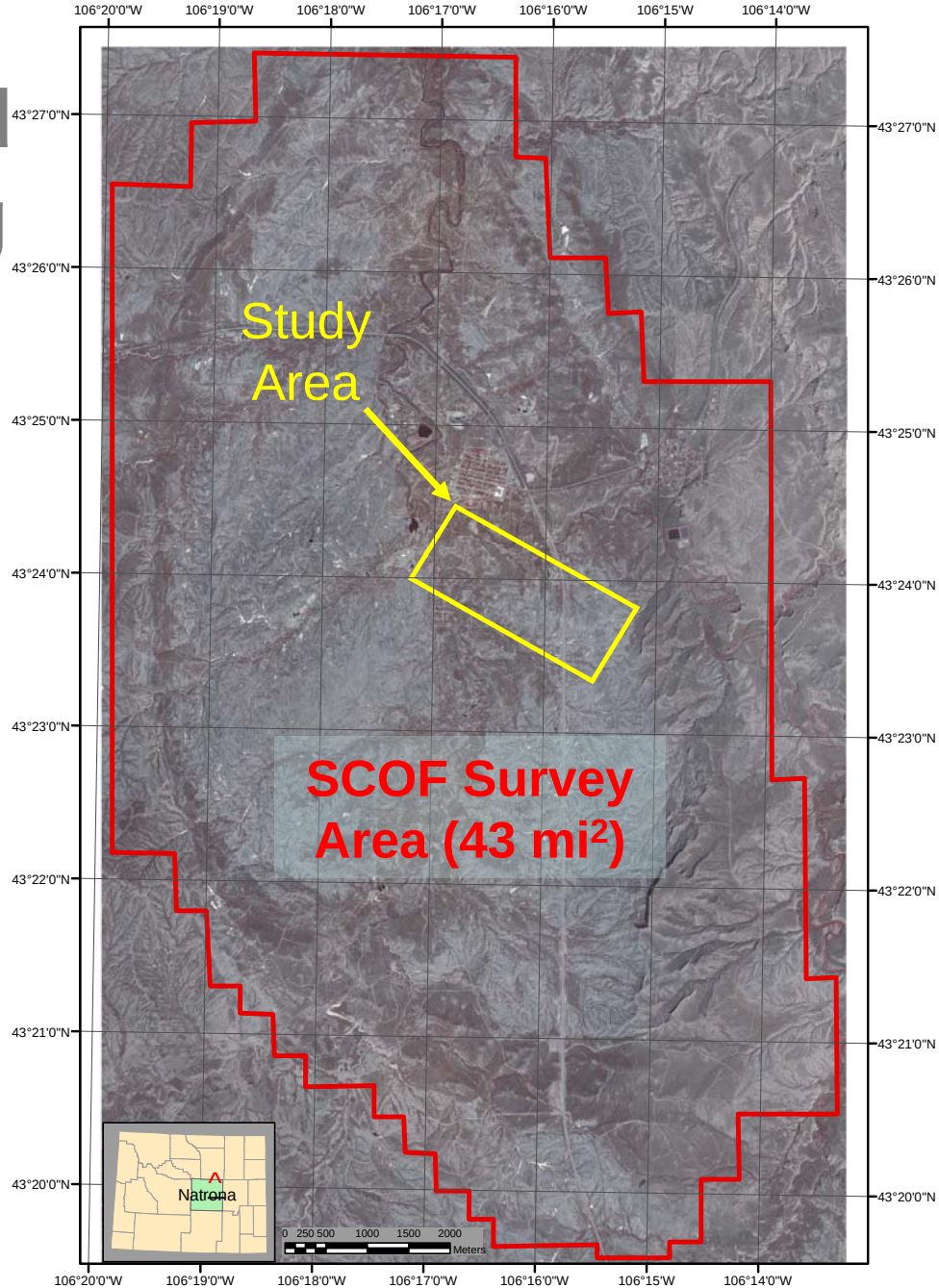
- Use magnetic surveys to locate steel-cased wells
  - Helicopter
  - Ground
- Use methane sensors to detect unplugged wells
  - Helicopter
  - Ground
- Use radiometric survey to detect radon from unplugged wells or radiobarite from production activity
  - Helicopter

LASEN

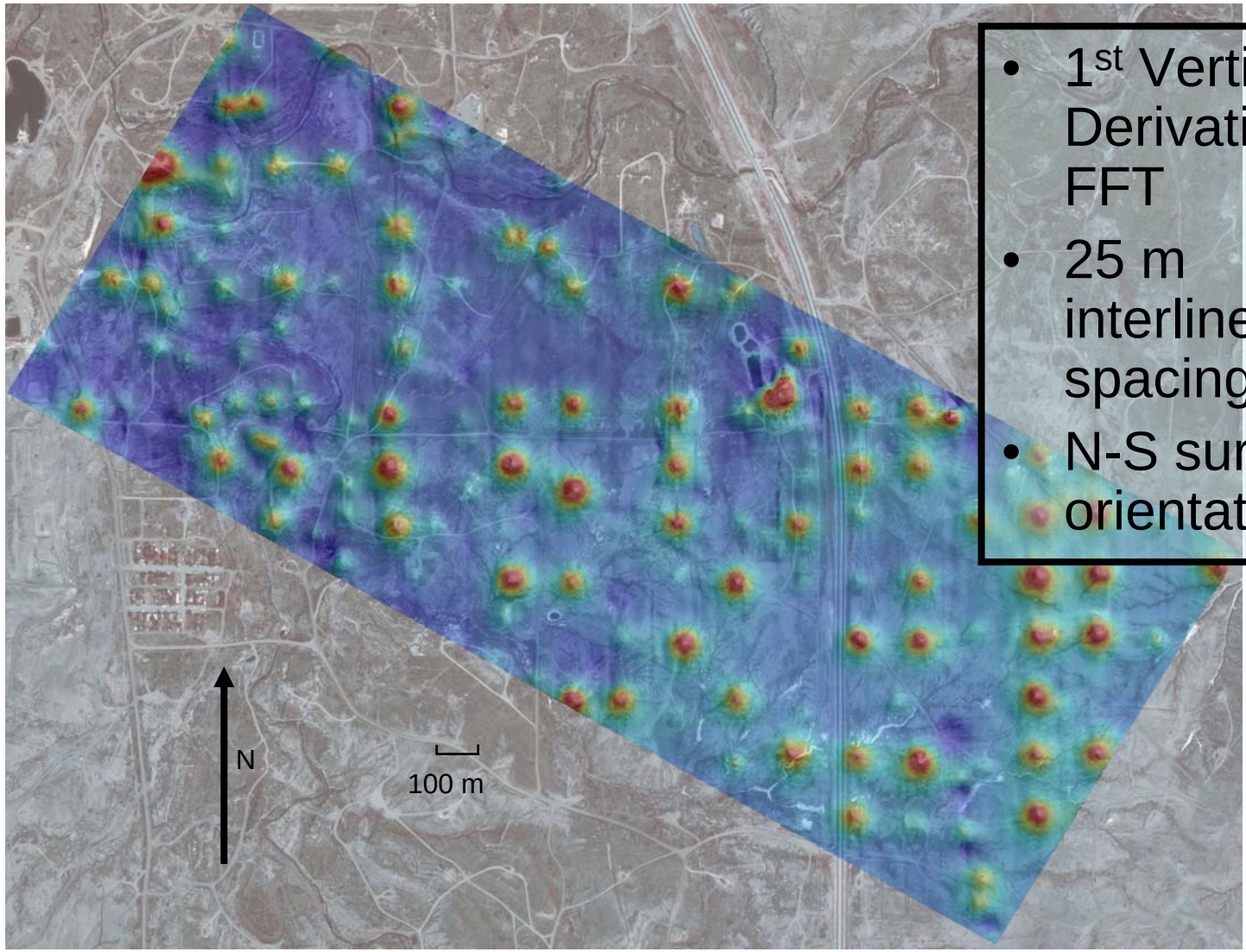

Magnetometers
Methane Detector

Salt Creek Oil Field
Midwest, Wyoming

- **Study Area Selection Criteria**
  - 1 square mile
  - Accessible
    - Terrain
    - Landowner
  - Existing well database
  - Wide range of well ages

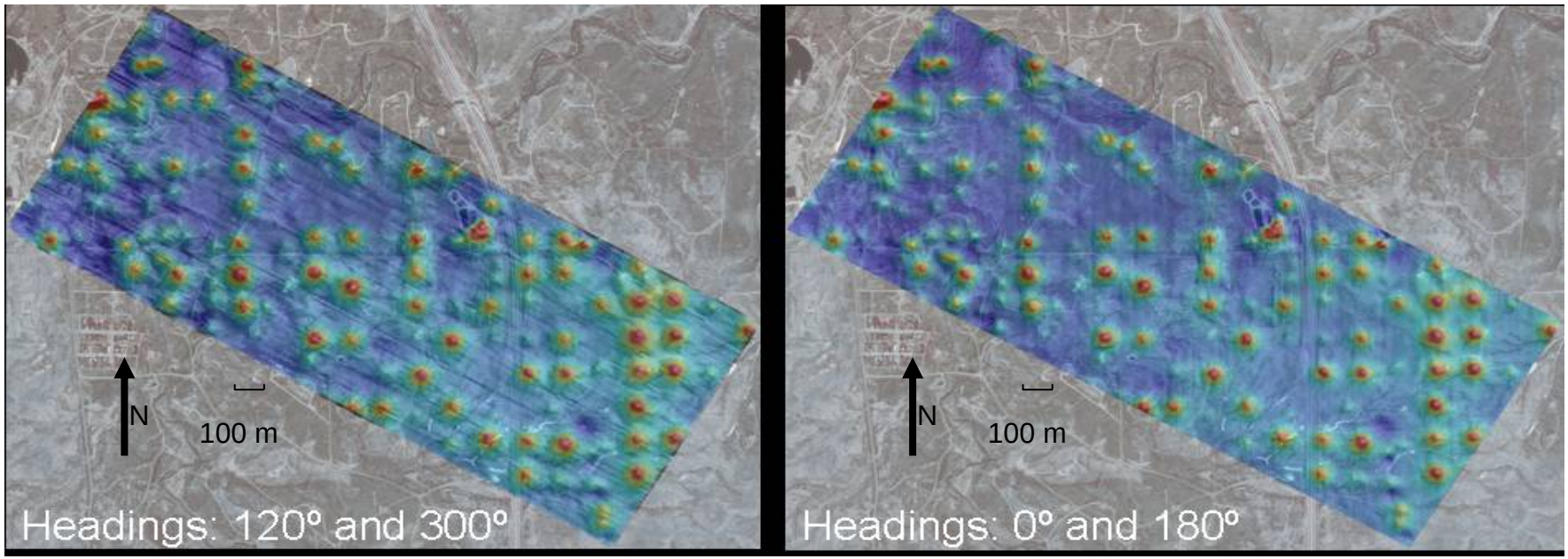


Helicopter Magnetic Survey

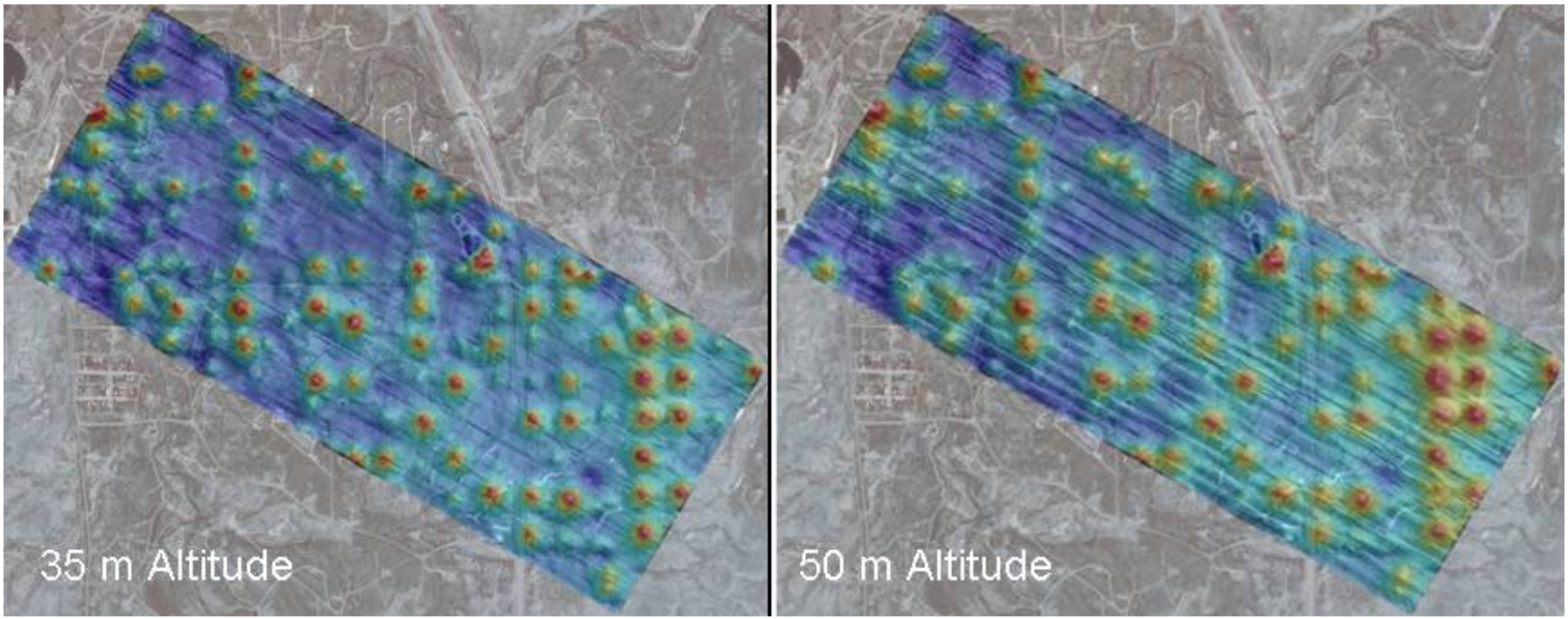


- 1st Vertical Derivative FFT
- 25 m interline spacing
- N-S survey orientation

Airborne Magnetometry- Effect of Survey Heading



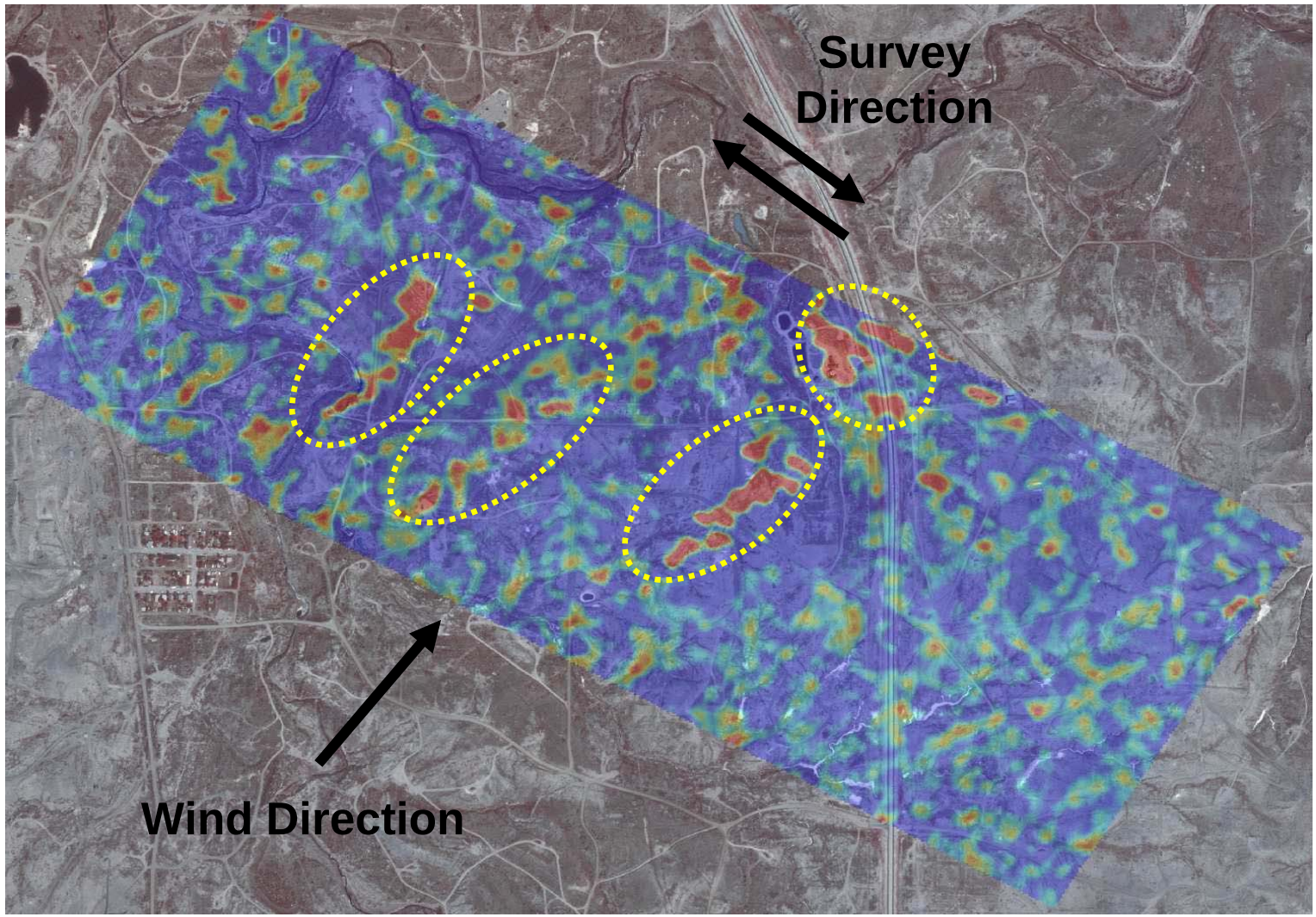
Airborne Magnetometry – Effect of Altitude

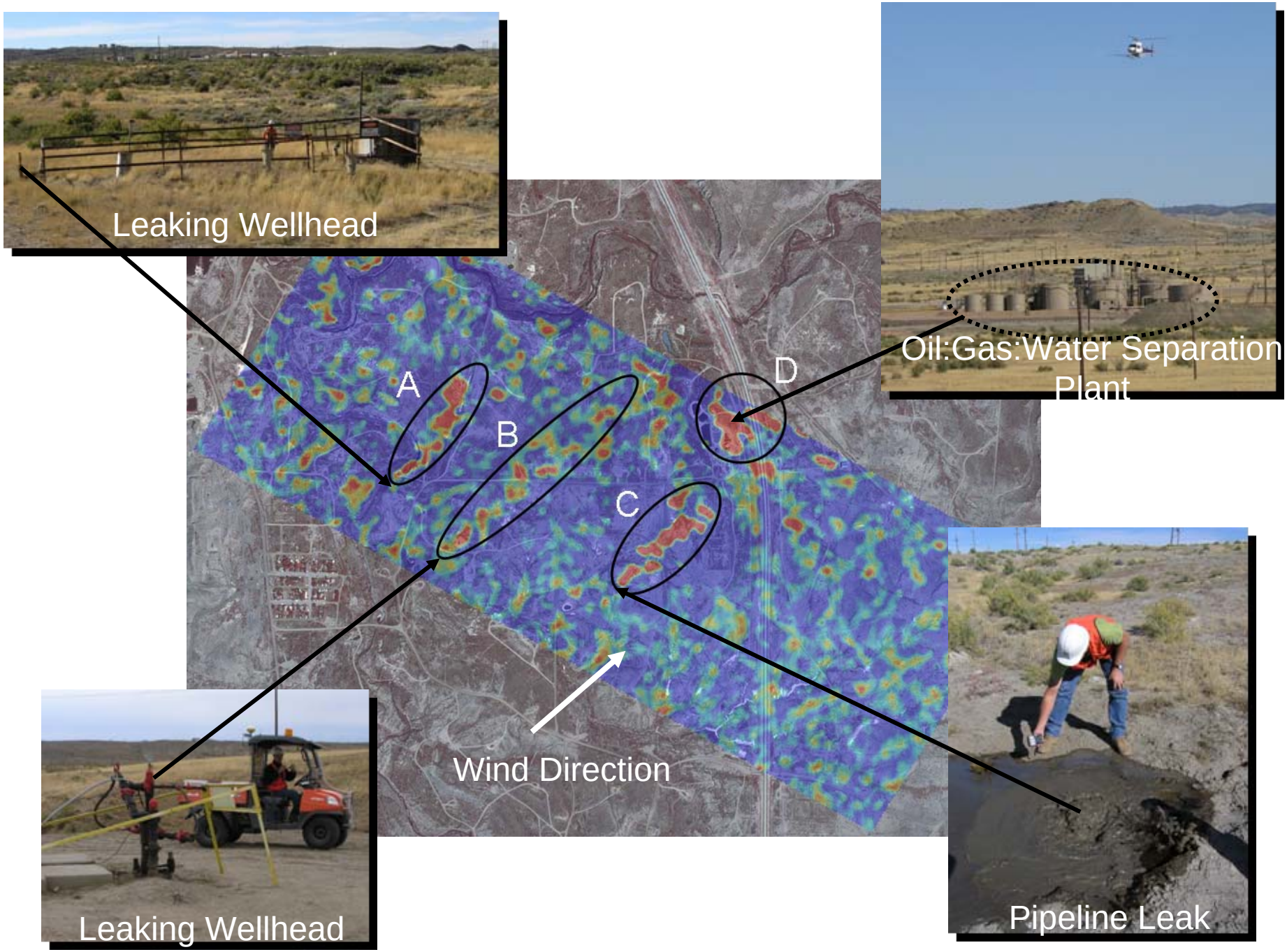


Helicopter Magnetic Results

Well-type magnetic anomalies	120
Well-type magnetic anomalies not in company database	34
Well locations in company database with no well-type magnetic anomaly	10

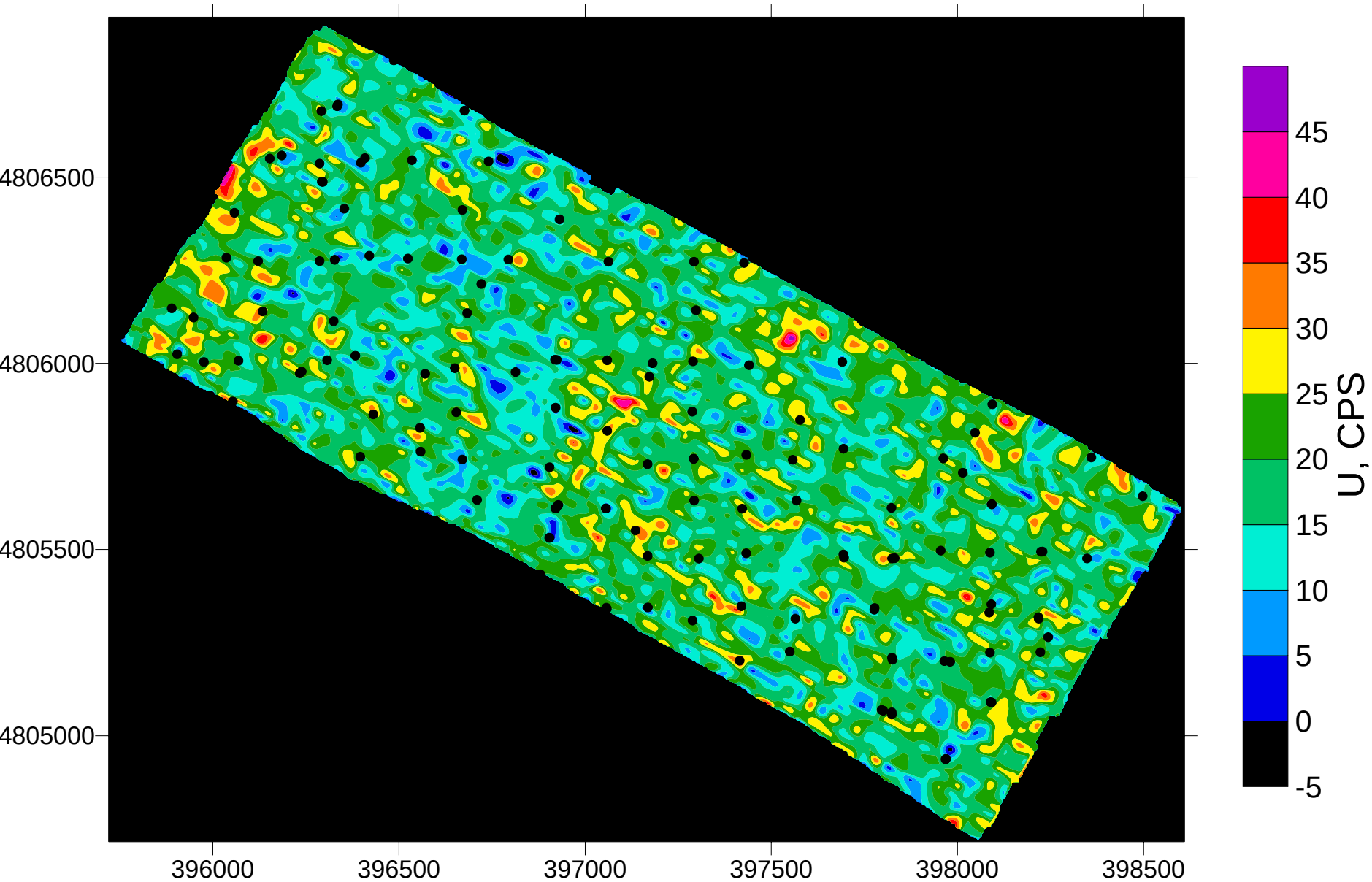
LaSen ALPIS Methane Data



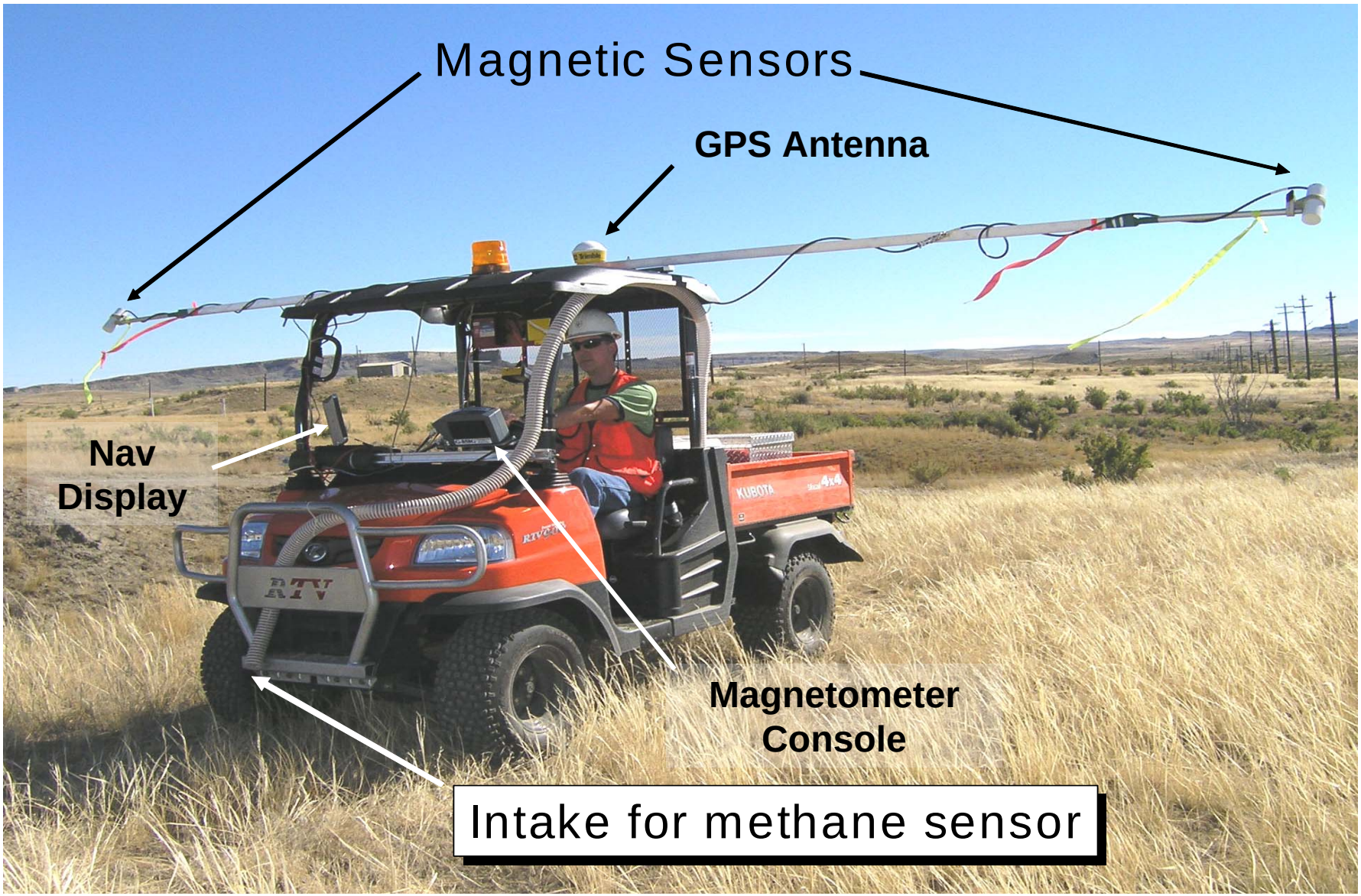

Leaking Wellhead
Oil:Gas:Water Separation Plant
A
B
C
D
Wind Direction
Leaking Wellhead
Pipeline Leak

Helicopter Methane Detection

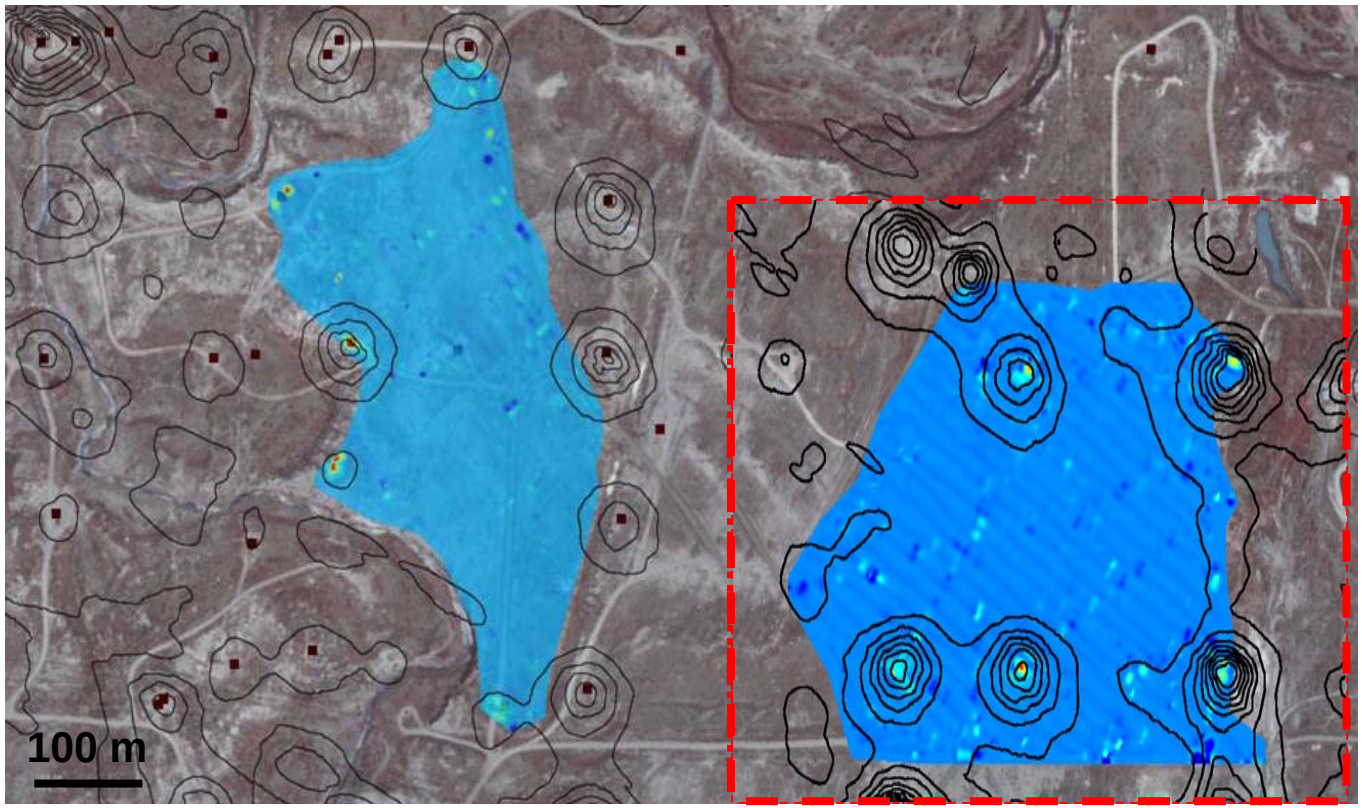
- Detected
  - 2 leaking wellheads
  - Leaking production pipeline
  - Emissions from separation plant
  - 4 ppm methane plume
- Did not detect
  - P&A wells
  - Non-magnetic cased wells
  - Fracture zones


4806500
4806000
4805500
4805000
396000
396500
397000
397500
398000
398500
45
40
35
30
25
20
15
10
5
0
-5
U, CPS

Ground Survey Vehicle



Ground Magnetometer Surveys



Contours:
Airborne Magnetic Anomalies

- **Wells**

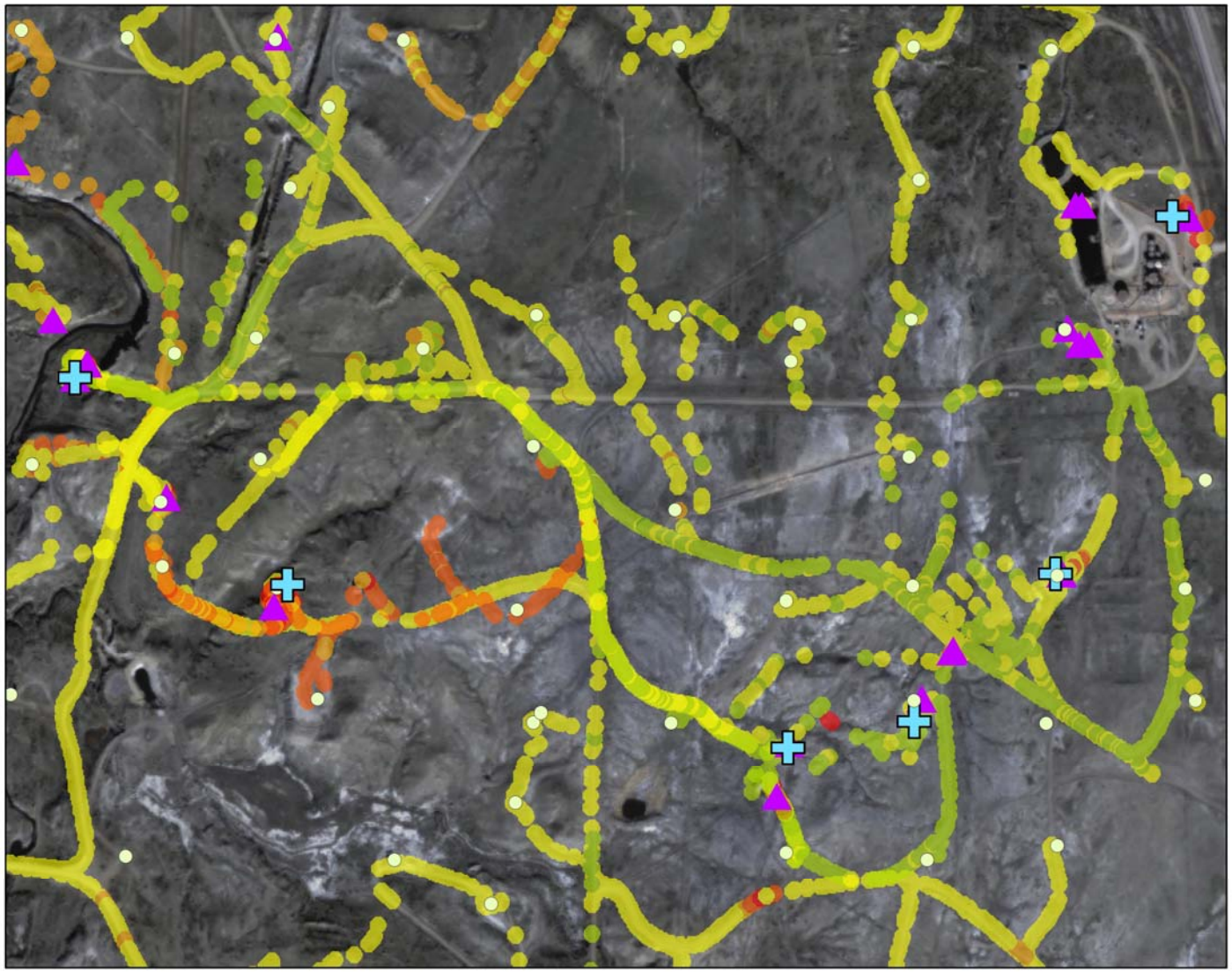
<u>Survey Parameters</u>:
10 m line spacing
0.1 second sampling interval

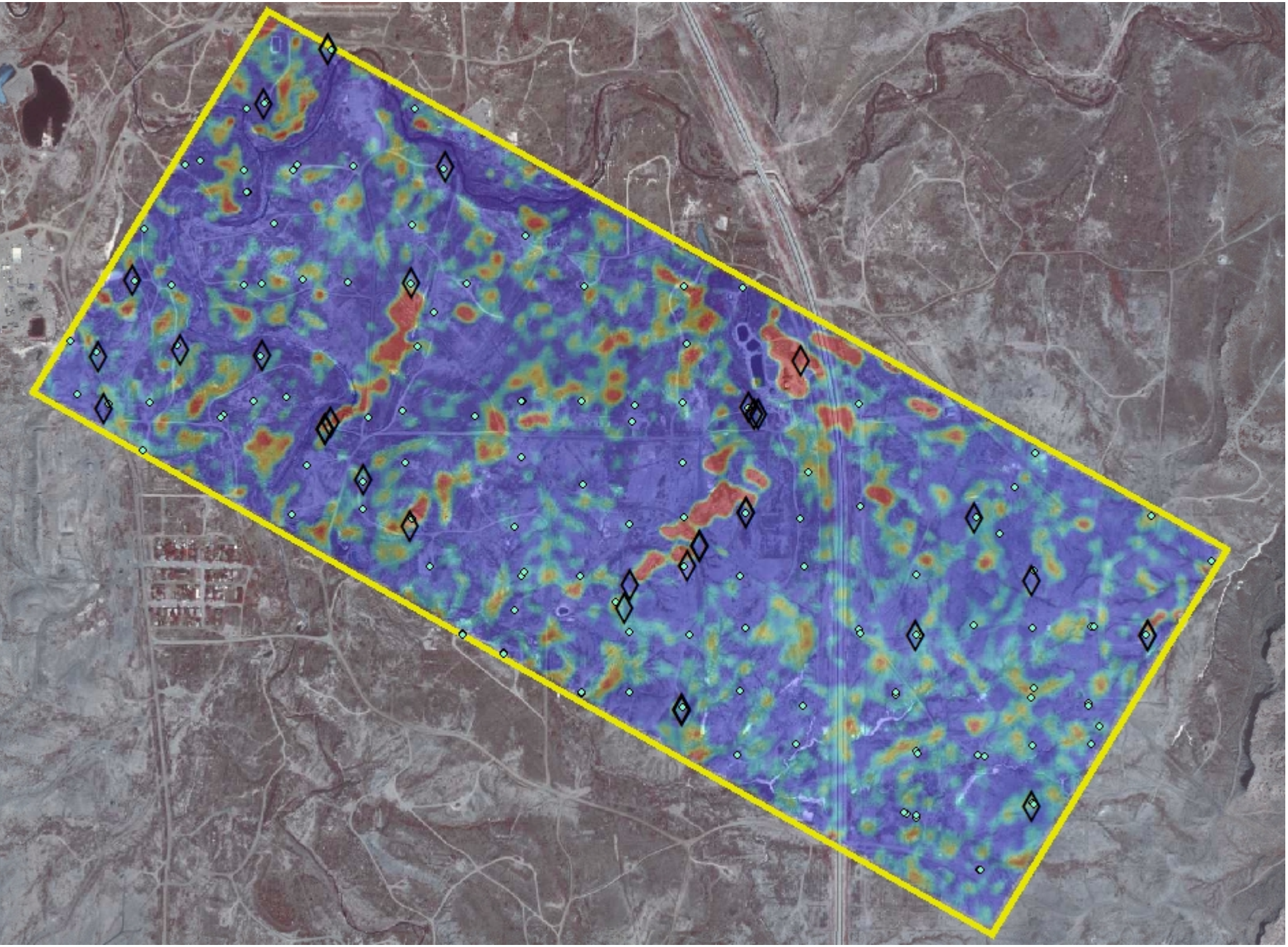
Sensor spacing = 6 m
Sensor Height = 2.1 m
Survey Direction = NW-SE

Apogee LDS

CH_4, CO_2, and total HC detector

Comparison of Apogee and LaSen Data

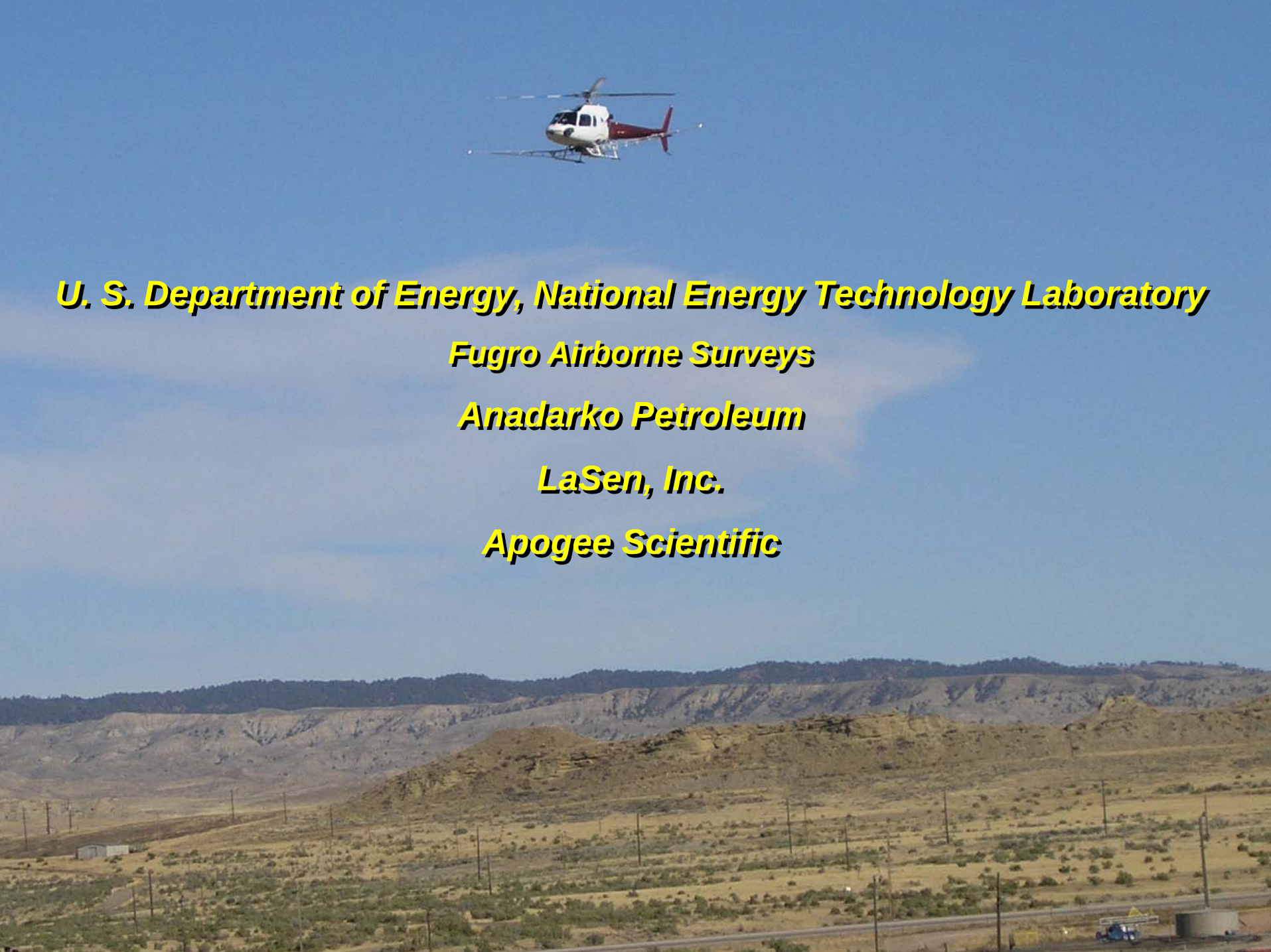




Early Conclusions

- Helicopter magnetic surveys detect > 90% of steel-cased wells
- Ground magnetic surveys are best for determining “dig areas” to uncover buried well heads
- Helicopter methane surveys using LaSen ALPIS can locate leaking oilfield infrastructure. (Detected methane plumes with concentrations of 4 ppm)
- Apogee LDS detects methane emissions at almost every well with pumping unit. Sensitive to changes of 0.2 ppm methane or less
- Helicopter radiometric surveys were not useful for locating wells

CASE



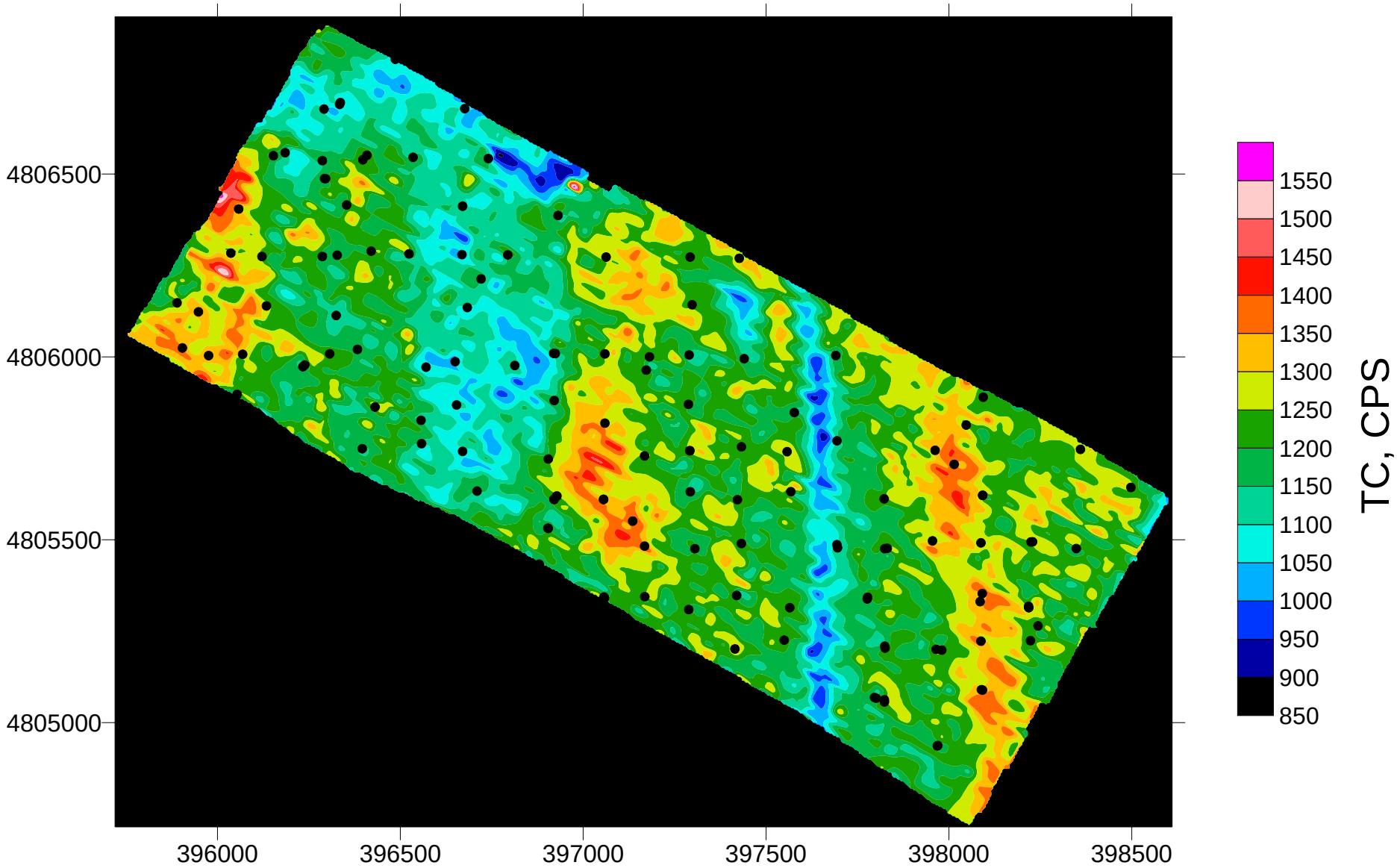
U. S. Department of Energy, National Energy Technology Laboratory

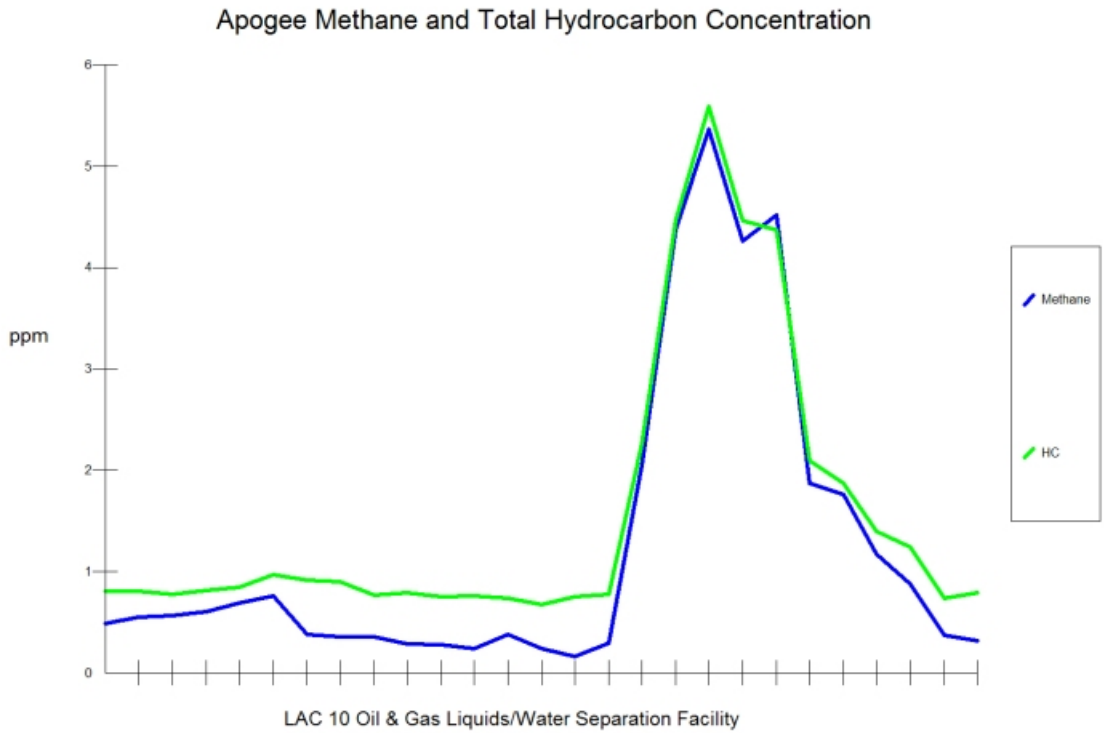
Fugro Airborne Surveys

Anadarko Petroleum

LaSen, Inc.

Apogee Scientific


4806500
4806000
4805500
4805000
396000
396500
397000
397500
398000
398500
1550
1500
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
TC, CPS


Apogee Methane and Total Hydrocarbon Concentration
ppm
6
5
4
3
2
1
0
Methane
HC
LAC 10 Oil & Gas Liquids/Water Separation Facility

DELTA
KUB