Remote sensing for Gas Operation Experience and Development at PG&E

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PG&E

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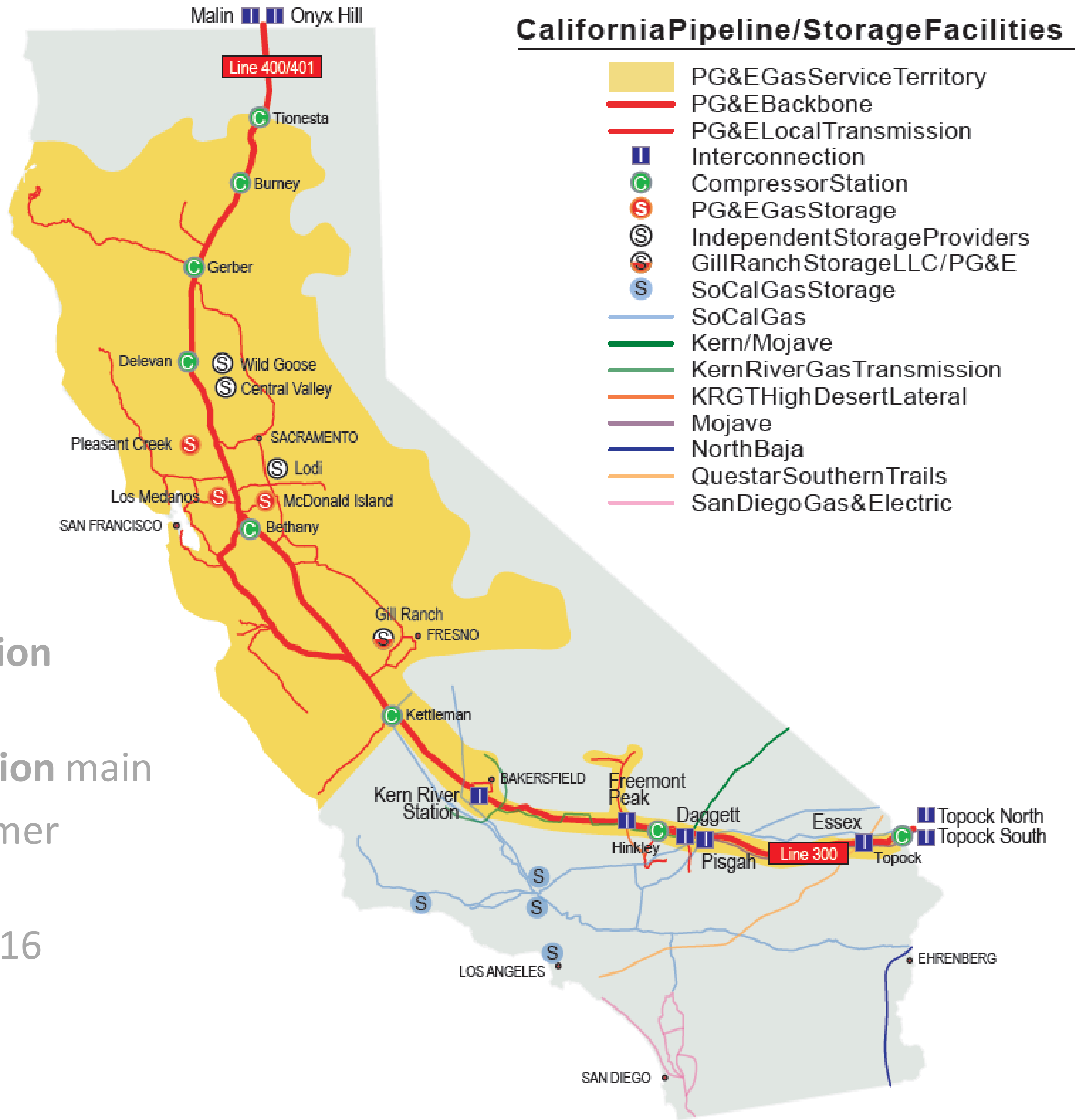
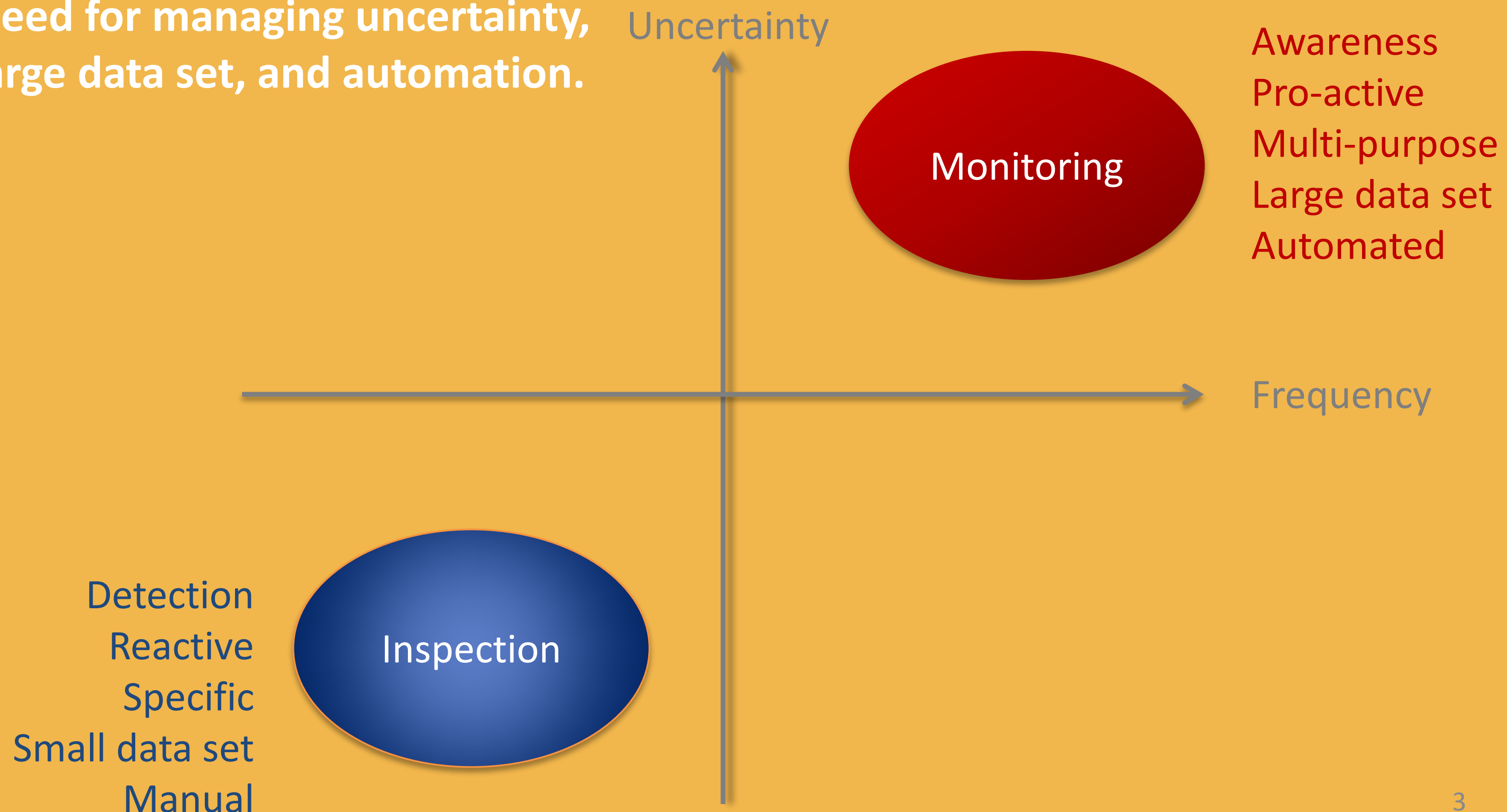
PG&E System



- Key Statistics
  - **6,600 miles** of gas **transmission** pipeline
  - **42,700 miles** of gas **distribution** main
  - 4.3 million natural gas customer accounts.
  - Throughput of 820 BCF in 2016

Remote sensing and monitoring vs Inspection

- Remote sensing and monitoring allows more frequent, including continuous, assessment of threats.
- **Need for managing uncertainty, large data set, and automation.**



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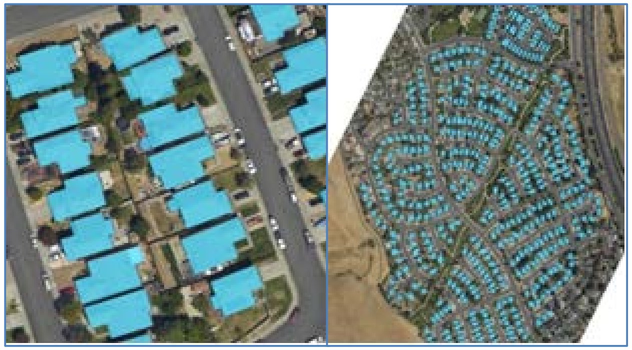
LiDAR data collection and processing



- LiDAR penetrates through vegetation canopy.
- LiDAR + IR + RGB allows for multiple opportunities.
- Data available for future analyses
- Applications
    - Structure Count/HCA
    - Topographic change, depth-of-cover, geohazards
    - 3rd party activities
    - Water crossing
    - Pipeline Marker Identification

Treatment of ground views for change detection from ortho-imagery, to hill shade view and topography change (removed in red; added in blue)

Emission Abatement

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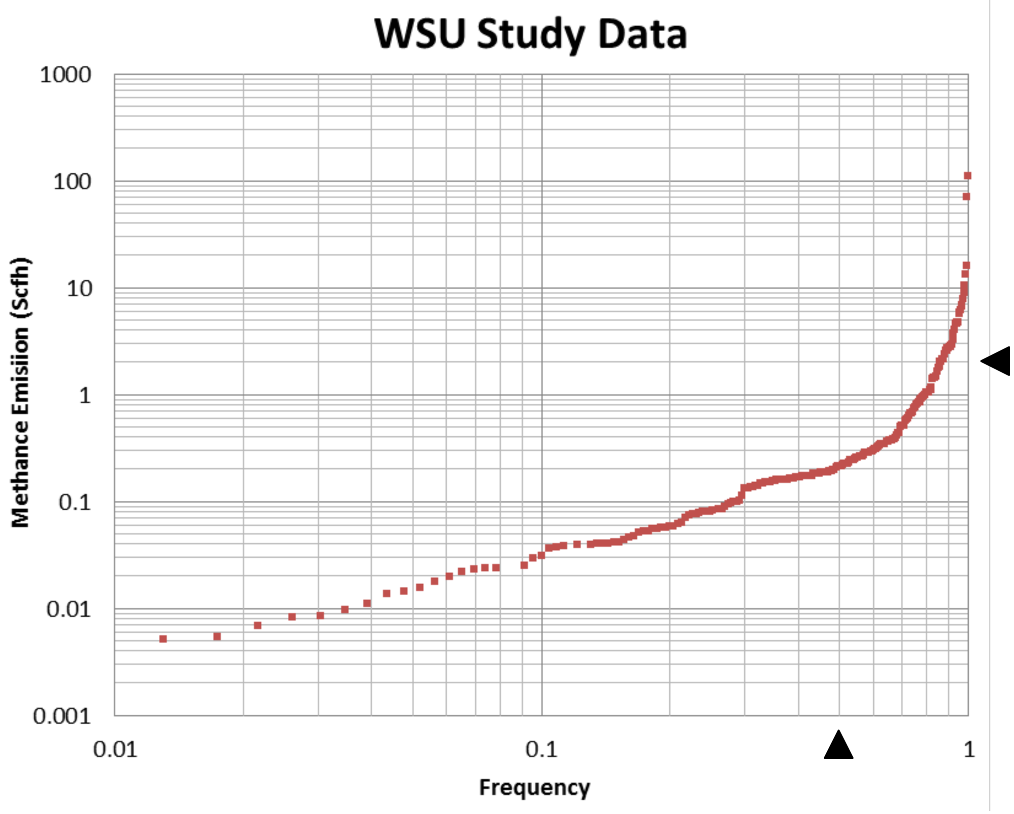
The concept of Super Emitters

- Methane emissions in gas distribution system are driven by a relatively small number of large leaks named Super Emitters.

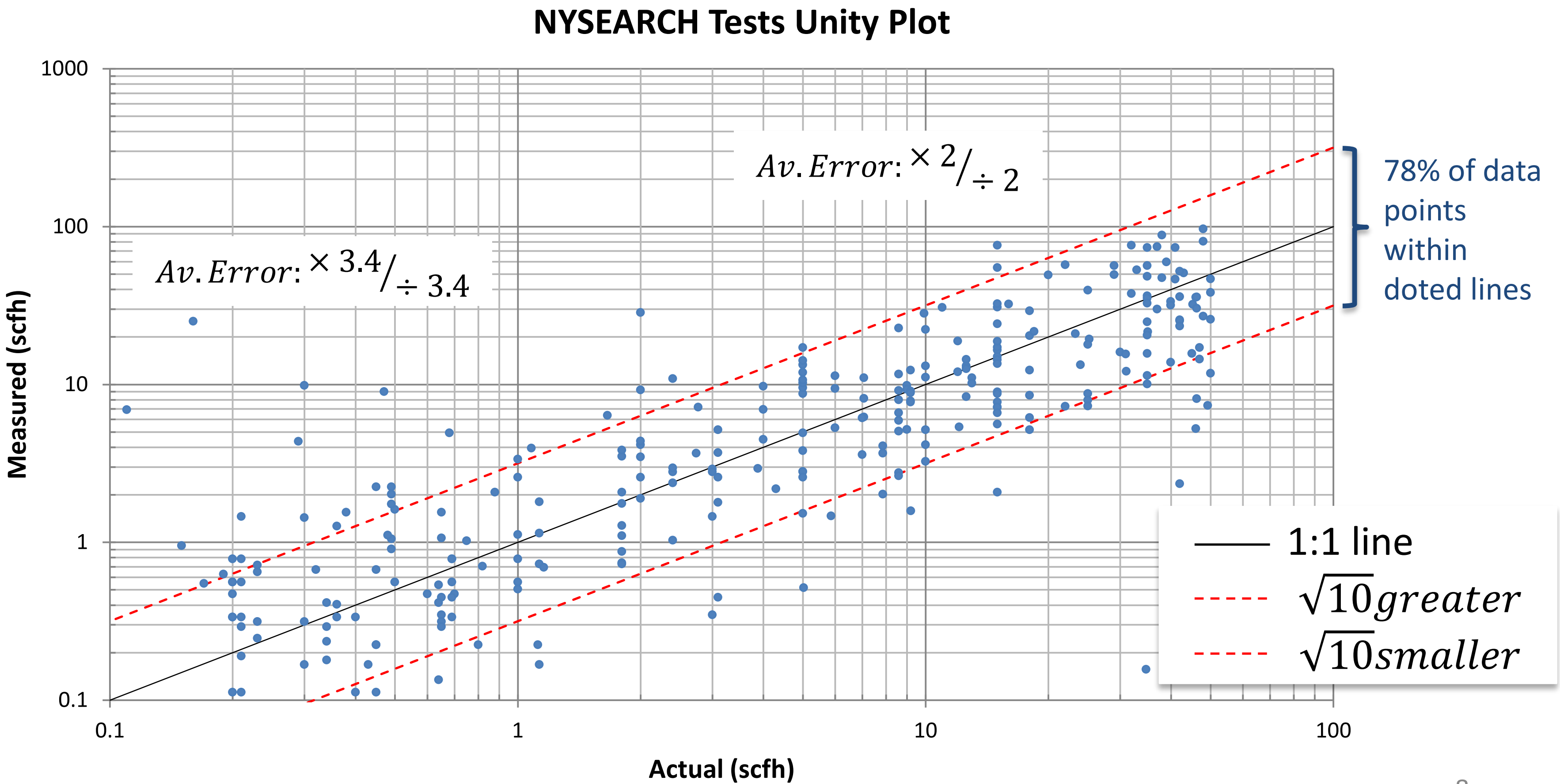


WSU study : Only 2% of leaks were > 10 scfh but accounted for 56% of total emissions

- Opportunity for substantially reducing methane emissions by accelerating detection and repair of large leaks.

Modeling monitoring uncertainty

- Large leaks are **easy to detect** with mobile surveys (Picarro).
- Leak flow rate quantification is still challenging with mobile devices but:
  - Solid data coming from NYSEARCH study is now available



78% of data points within doted lines

Proposed program

1. Drive Picarro car on an accelerated basis (eg. once a year)
2. Filter out any indications <10 scfh (Picarro's algorithm)
3. Investigate and repair leaks associated with large indications (>10 scfh)
4. Calculate abatement including impact of uncertainties.

Few hundred leaks to repair for 20% of abatement
About 30 time more cost effective than repairing all leaks

Risk Based Leak Survey Inspection

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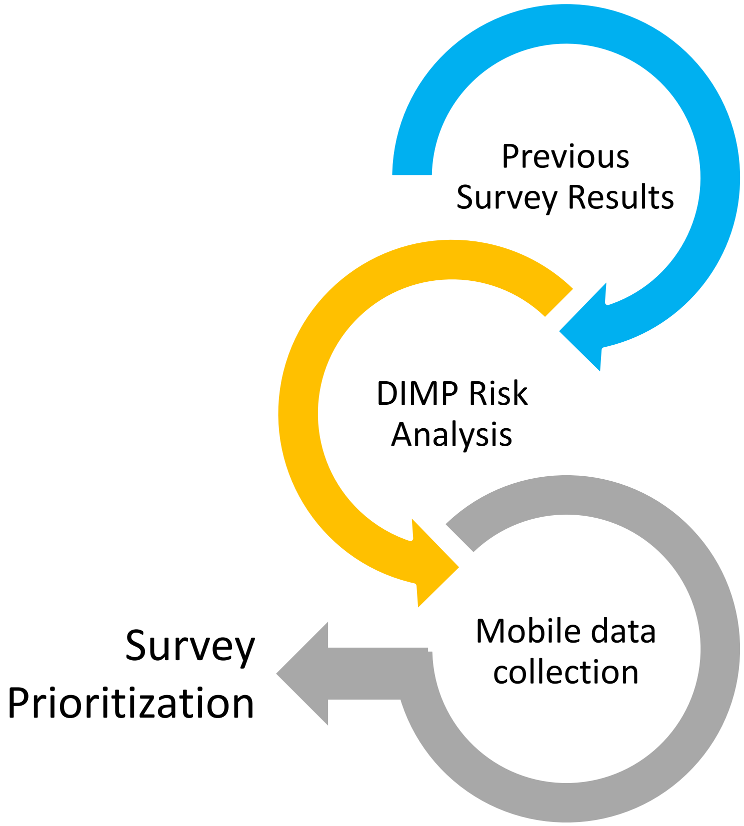
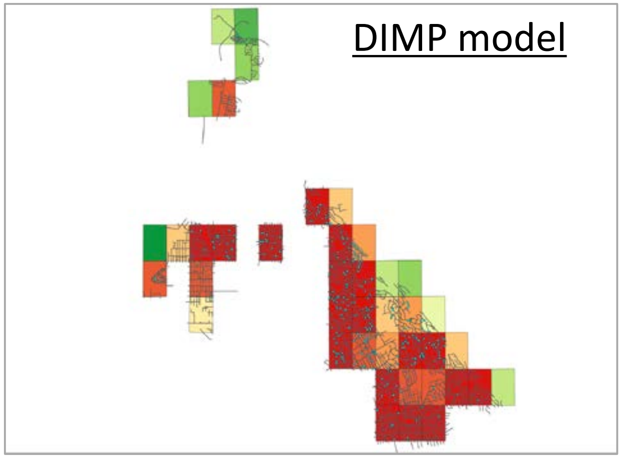
What is risked based leak survey?



1. Determine maps with higher risk of developing leaks by DIMP modeling
2. Refine risk by adding up-to-date methane concentration measurements
3. Restack maps to be surveyed in function of the number of leaks to be found

Evaluating the probability of leak density



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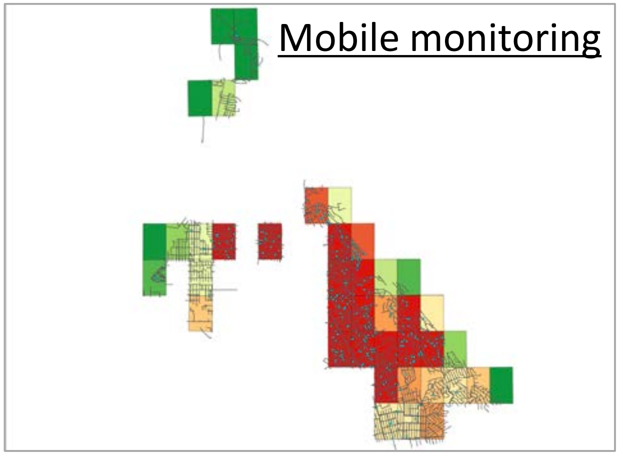
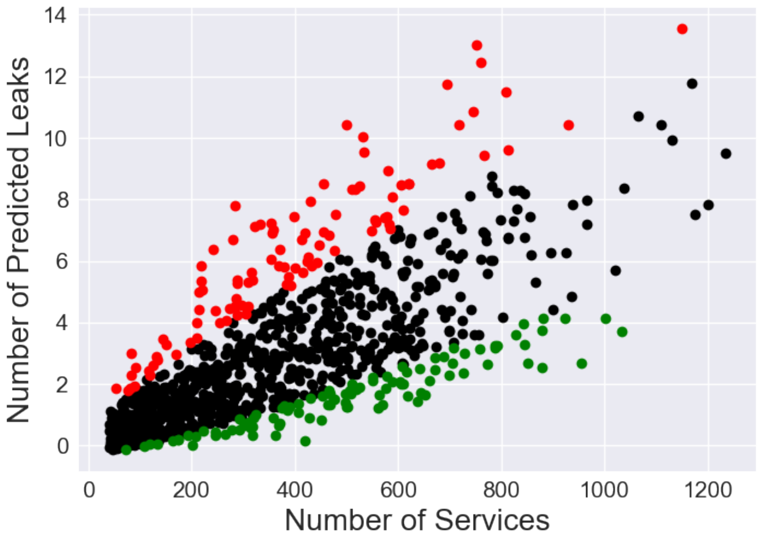
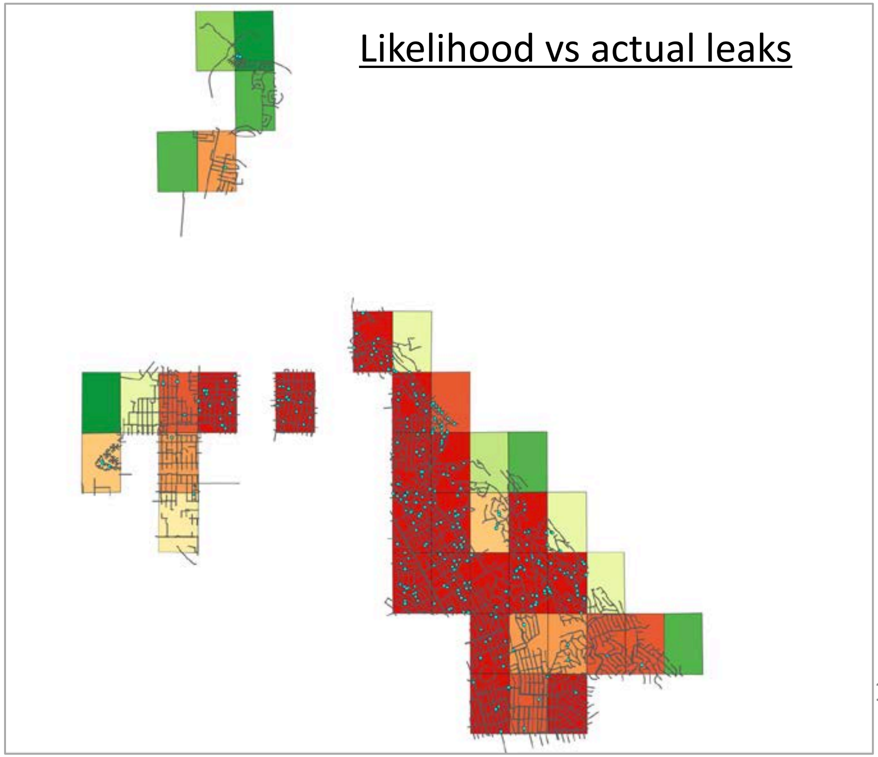


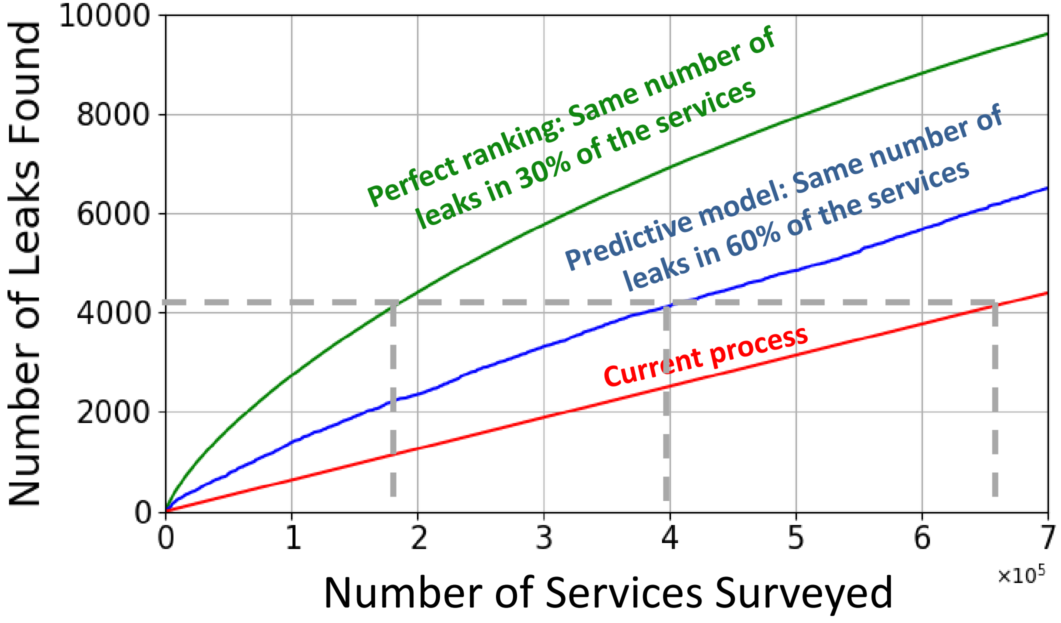
Plat sizes are normalized by their number of services

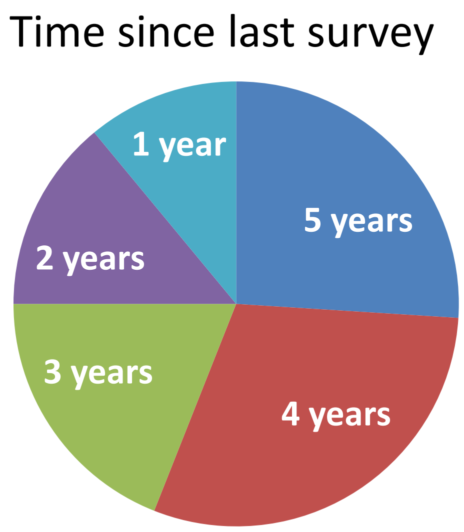




Optimization of leak surveys

1. Run the DIMP risk model
2. Monitor areas with mobile methane detector
3. Compute likelihood of leaks on plats normalized by number of services
4. Restack the plats to be surveyed based on likelihood of leaks





In conclusion

- New technologies allow data collection on a broad range of parameters at an accelerate frequency.
- This information helps generate awareness about risk and impact of gas infrastructure.
- This awareness can be processed, accounting for uncertainties, to optimize inspection and maintenance activities.

R&D efforts are needed in:

1. Improving remote sensing capabilities
2. Improving quantification of monitoring uncertainties
3. Developing and validating probabilistic methods to interpret results of remote sensing and monitoring
4. Integrating multiple sources of large monitoring data sets to drive actionable recommendations

Thank you

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