Variability in Real-World Performance of OGI-Based Leak Detection Surveys

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Current approaches to methane leak detection not well-suited for evolving understanding of methane emissions

- Most jurisdictions use optical-gas imaging (OGI) based leak detection surveys
  - Survey every component at facility
  - 1/2/4 times per year
  - Survey time: 3 – 5 sites/day
  - Survey cost: $600/site, $3000/day

- OGI-based surveys are effective in reducing emissions across years

- Question: What is the stochasticity in OGI-based leak detection surveys?

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Repeated leak detection and repair surveys reduce methane emissions over scale of years

Arvind P Ravikumar[1,7], Daniel Roda-Stuart[2,5], Ryan Liu[3,6], Alexander Bradley[3], Joule Bergerson[3], Yuhao Nie[2,4], Siduo Zhang[4], Xiaotao Bi[4] and Adam R Brandt[2]

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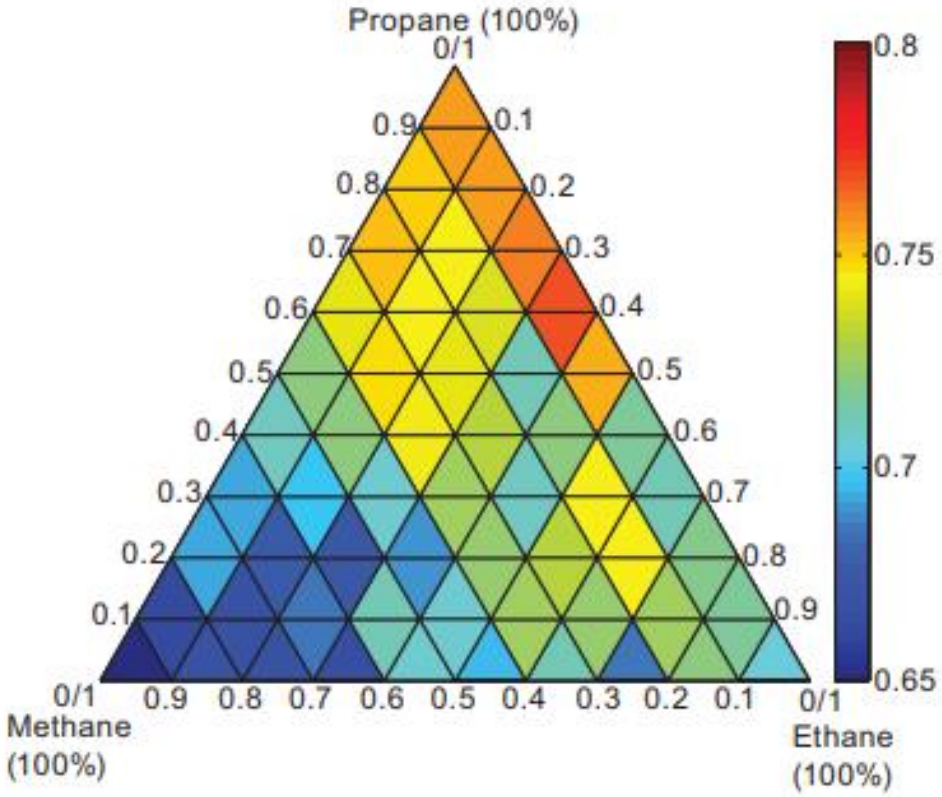
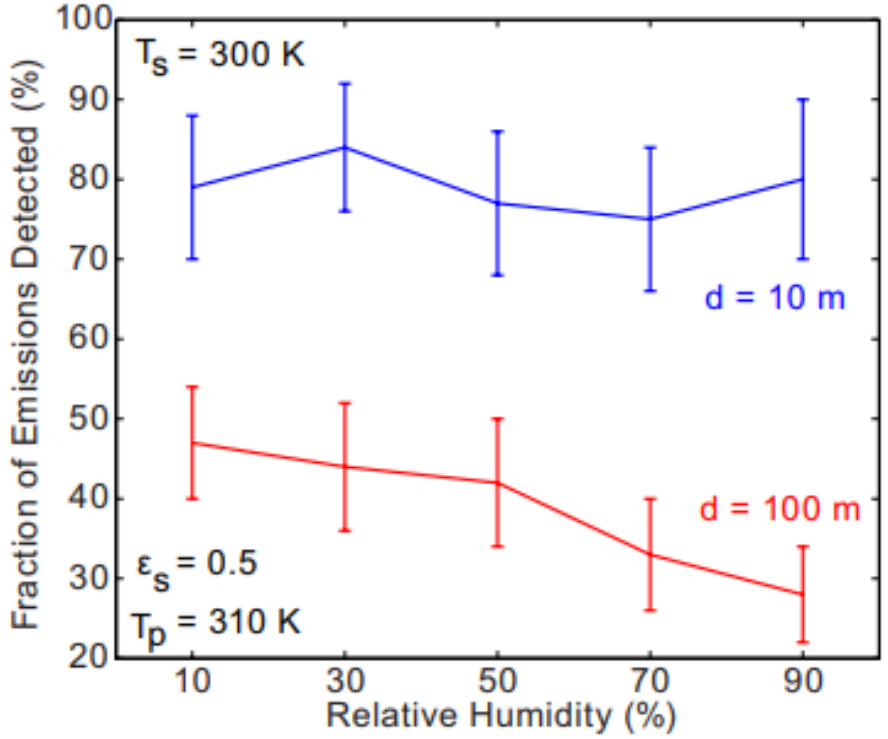
A.P. Ravikumar et al. ERL (2020)

Intrinsic Variability: Sensitivity of OGI-based leak detection is affected by environmental conditions

Gas Composition



Humidity

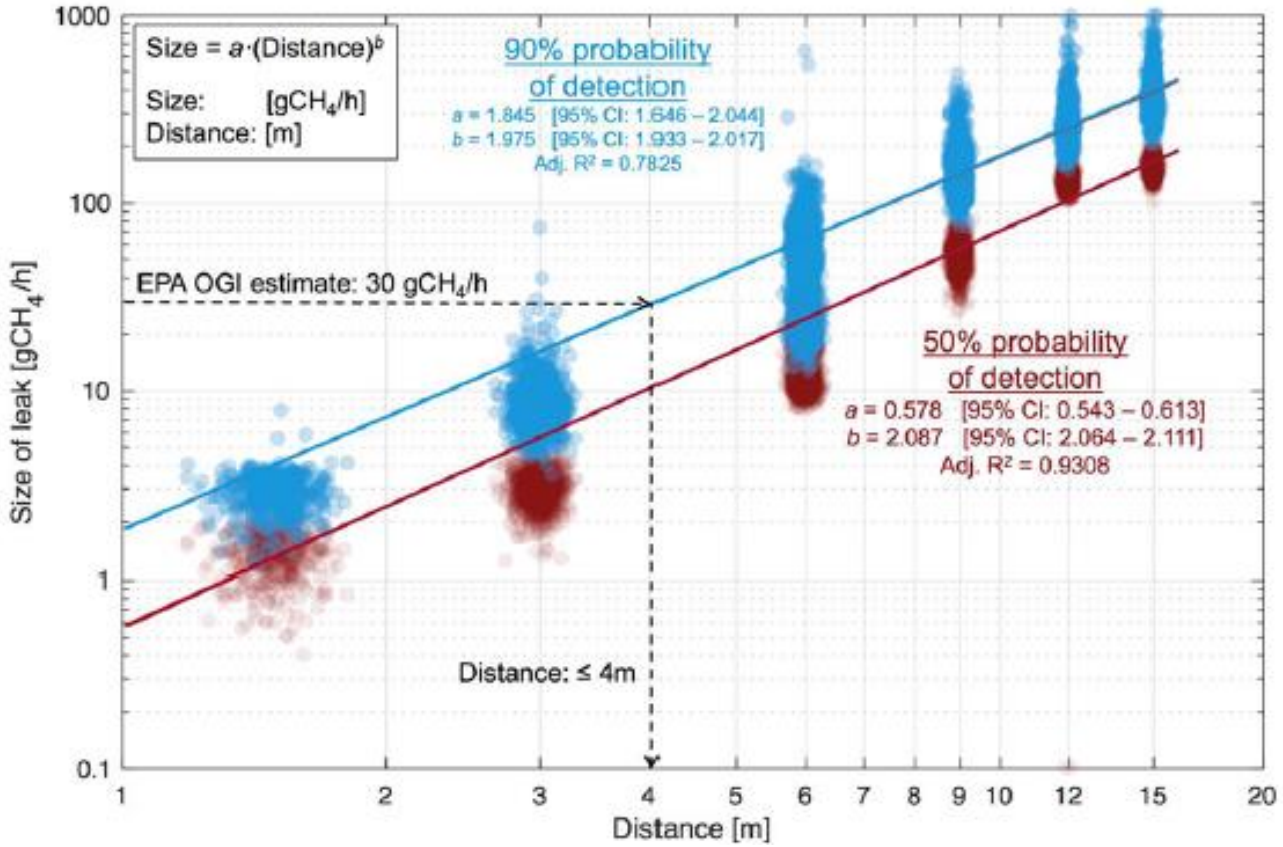


A.P. Ravikumar et al. EST (2017)

Other variables: Temperature, wind speed, cloud cover

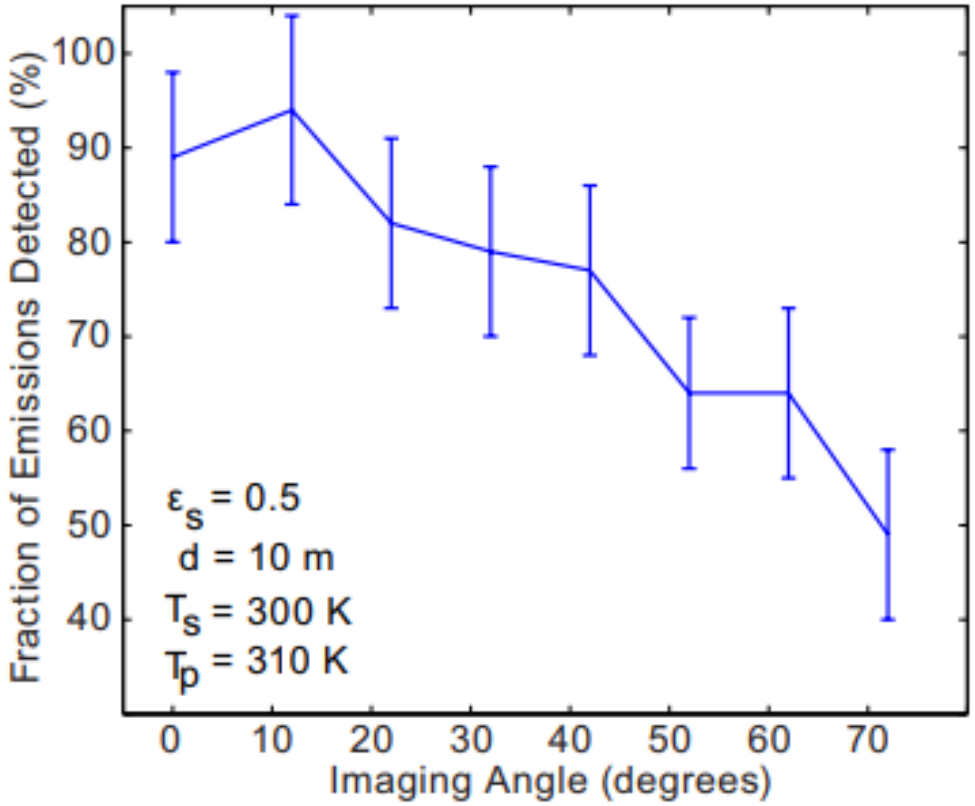
Extrinsic Variability: Sensitivity of OGI-based leak detection is affected by imaging distance and operator experience

Imaging Distance



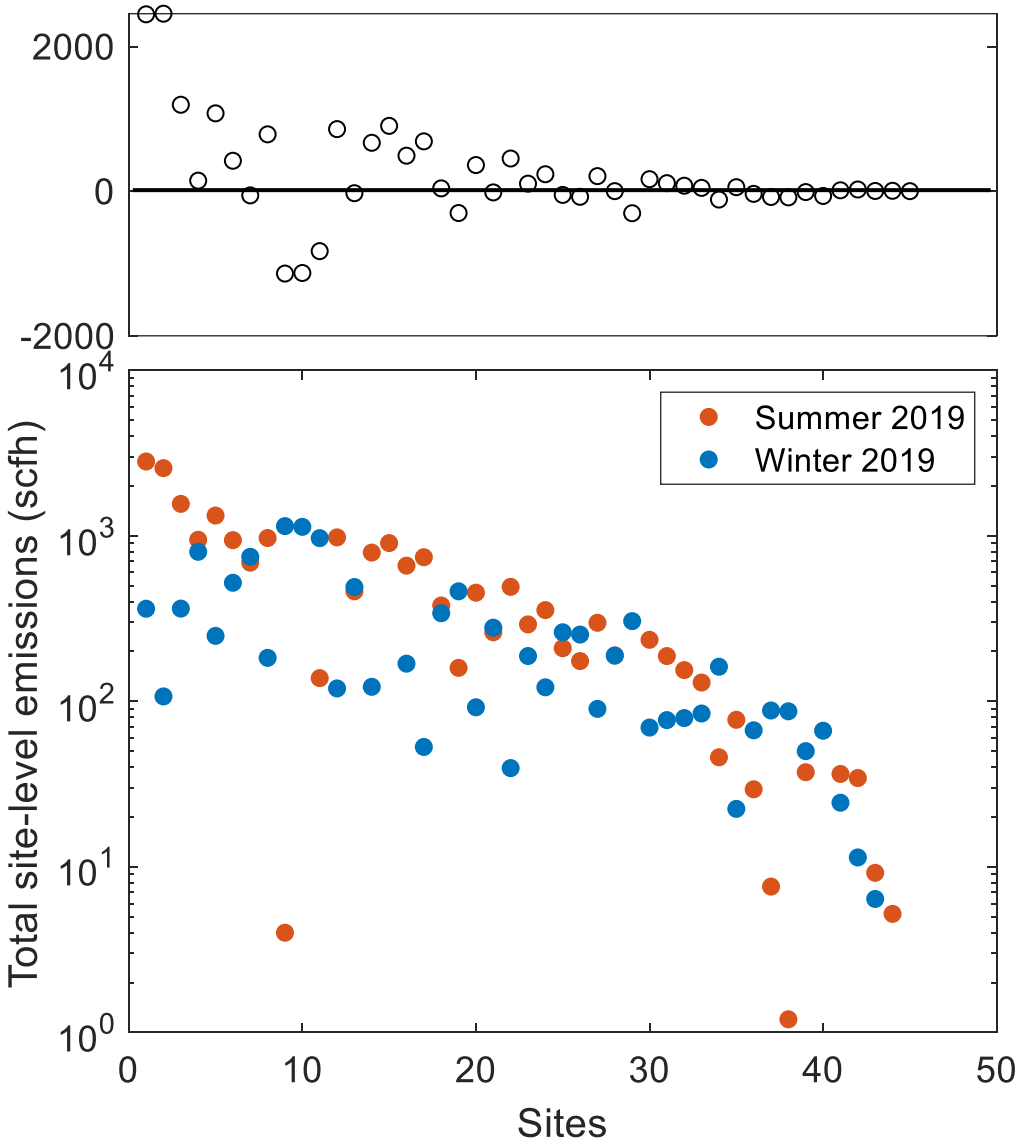
A.P. Ravikumar et al. EST (2019)

Imaging Angle



Other variables: Operator experience

Intermittent emissions can significantly affect emissions estimates

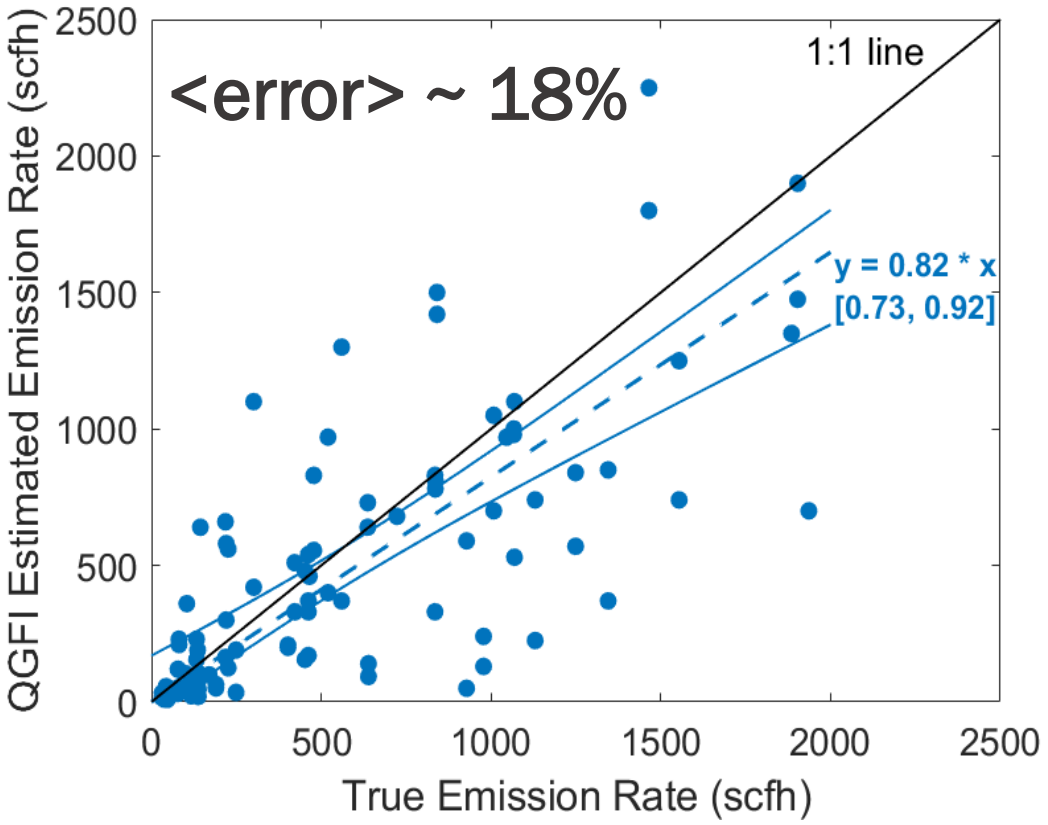


- Some equipment-level emissions are temperature dependent
- Tank flashing – more prone in summer because of higher temps
  - Intermittent
  - Higher volumes
- Fewer detected tank-related intermittent emissions in winter

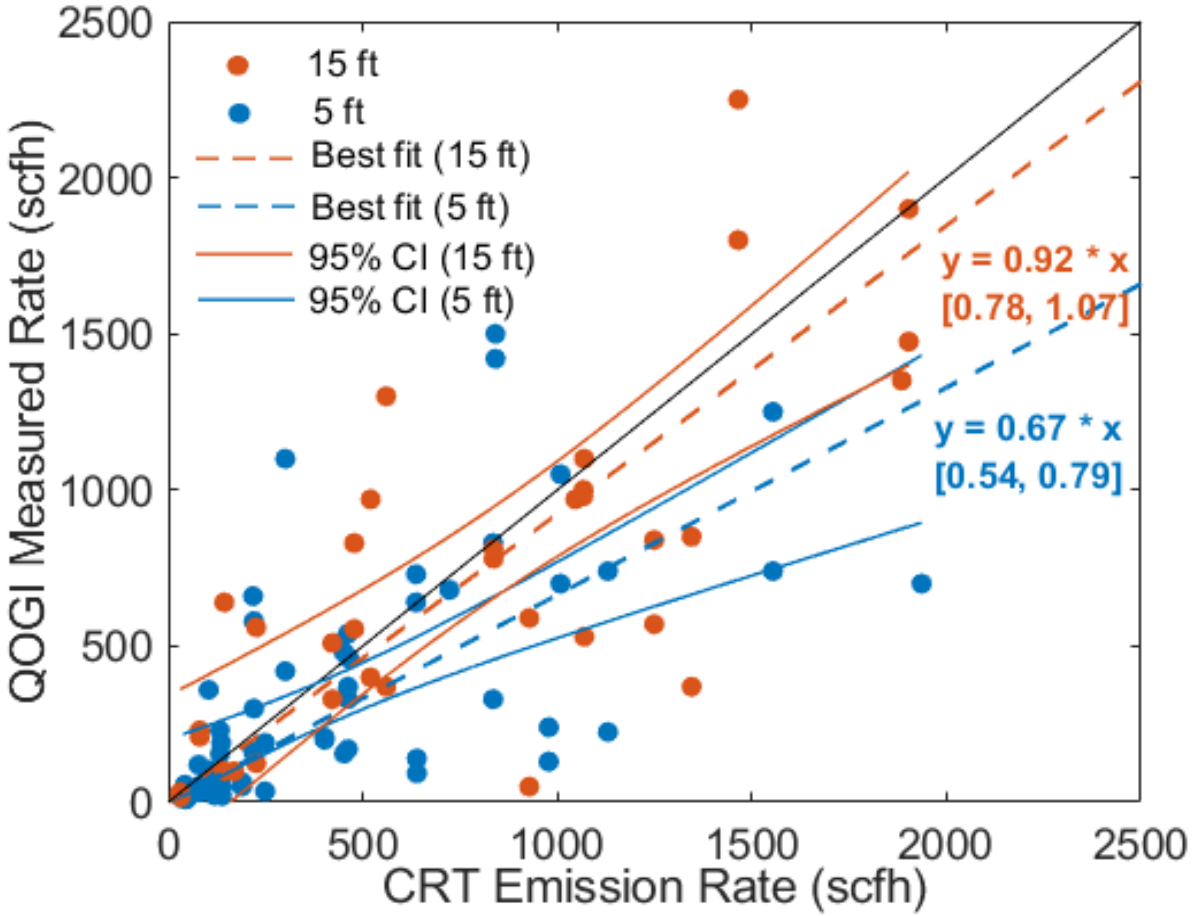
Controlled release tests provide indication of error in baseline OGI measurements

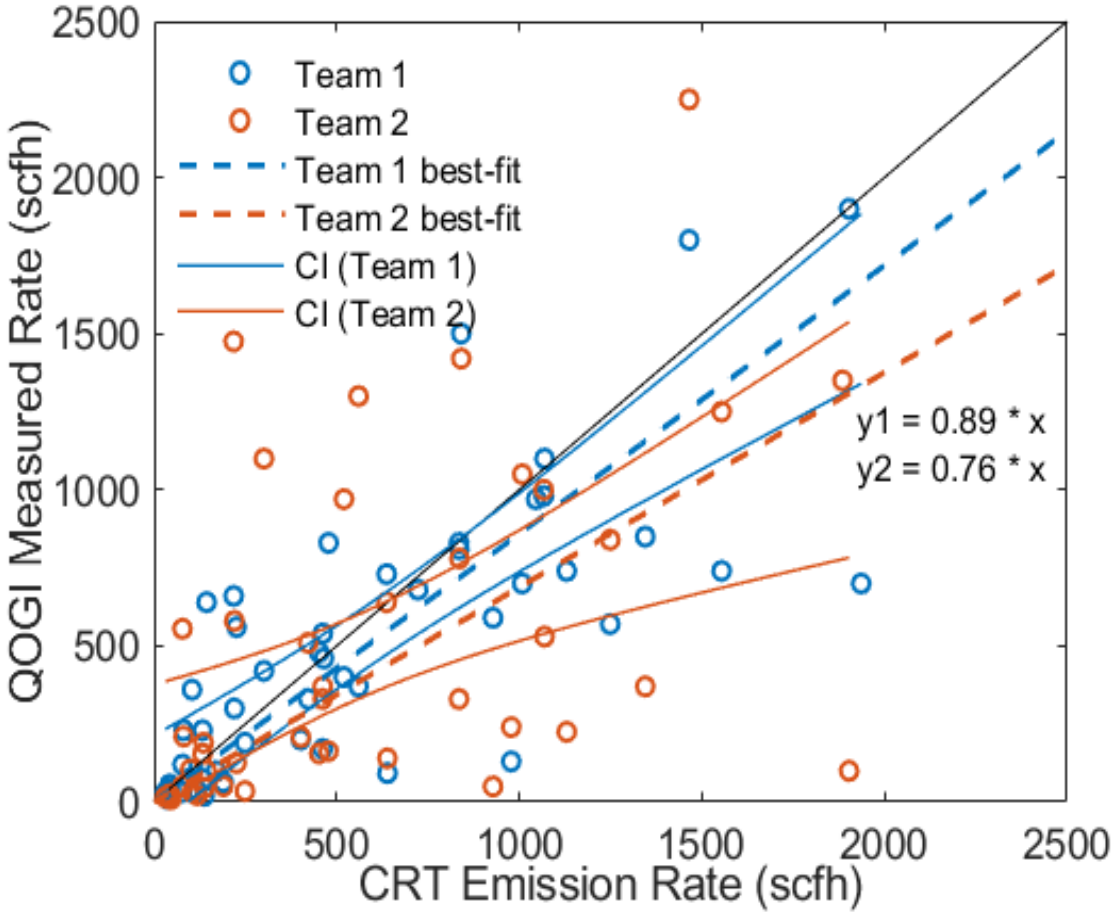
Providence Photonics quantitative optical gas imaging (QOGI) instrument

- Is it effective in quantifying emissions?

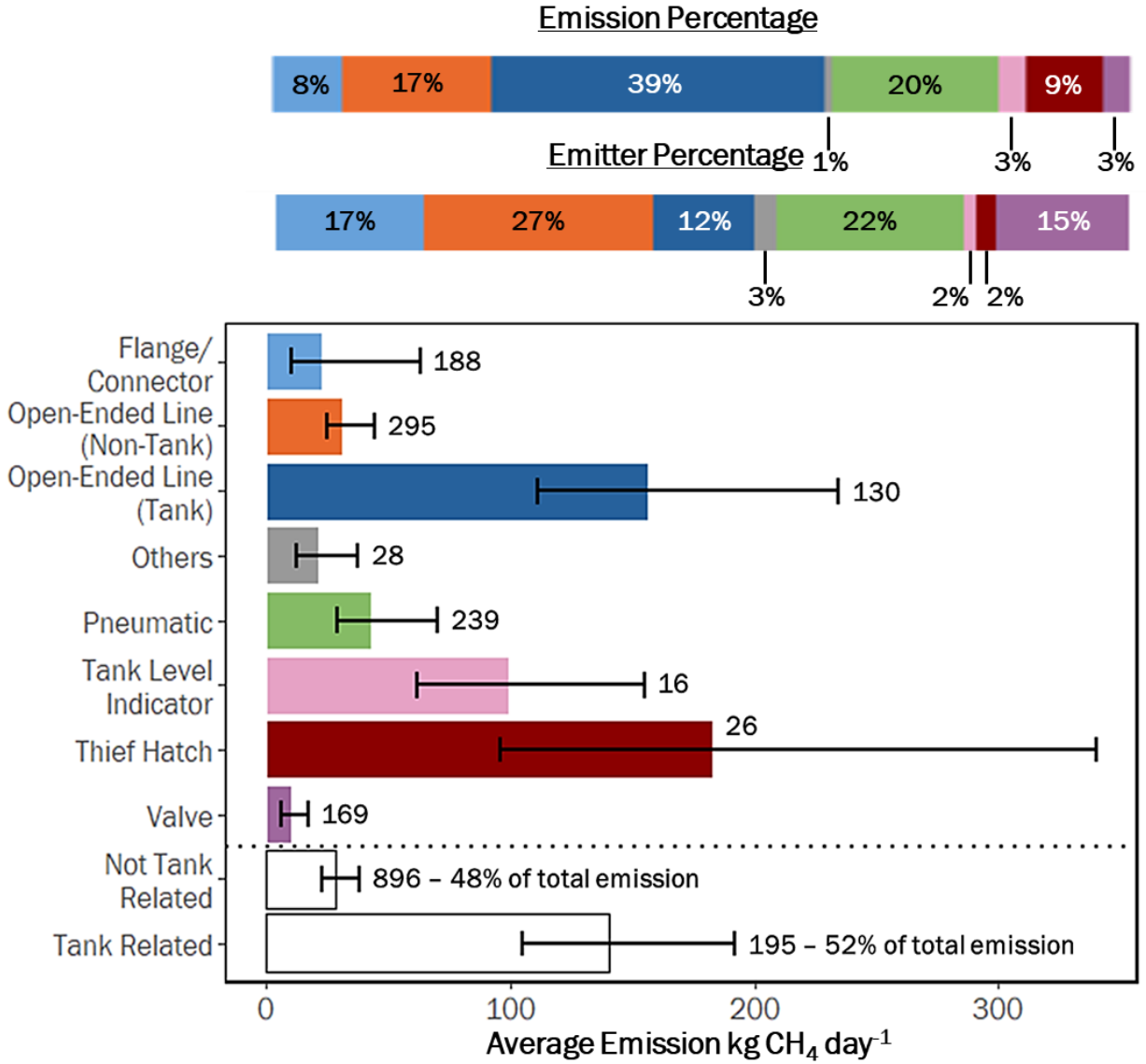


QOGI performance mirrors OGI camera performance: better at estimating taller emissions and improves with operator experience



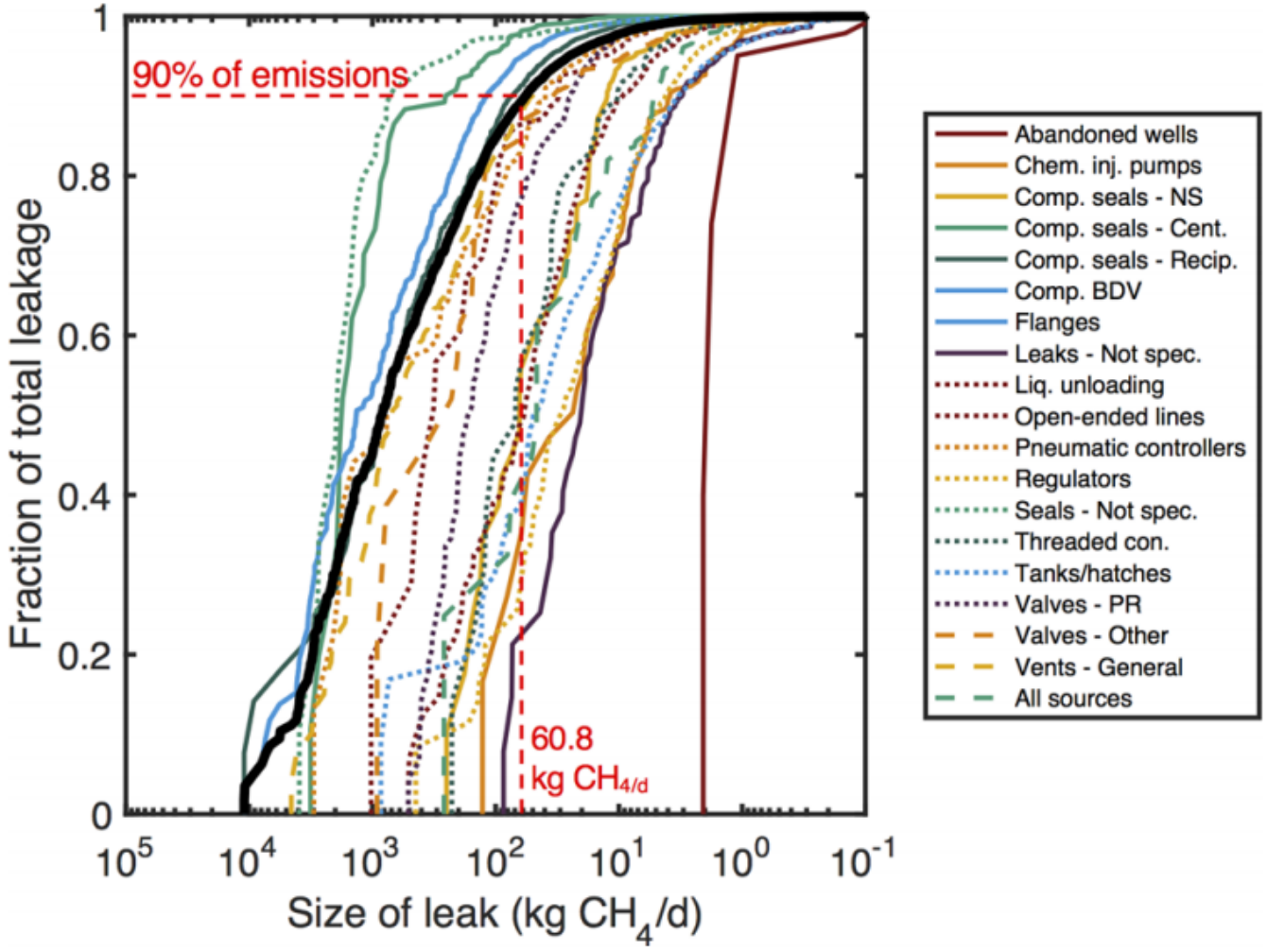


Effectiveness of OGI-based leak detection depends on the emitting component



- Some components are more prone to being super-emitters than others
- Large number of leaks from flanges and valves (30+%), but contribute only to ~10% to total emissions
- **There will be differences across crews, but: *are you finding the 'big' leaks consistently?***

Daily calibration checks on OGI (e.g., 30 g/h source as in OOOOa) is important, but can have higher thresholds because of skewed emissions distribution



A.R. Brandt et al. EST (2017)

Summary: What does variability of OGI-based leak detection tell us about the effectiveness of LDAR surveys?

- ***Control extrinsic variables:*** Use best-practices for imaging (closer distance, high contrast background, line-of-sight), and effective training
- ***Place reasonable limits on intrinsic variables:*** Avoid extremes of wind, rain, humidity, temperature (low)
- ***De-emphasize minimum detection limits:*** most emissions come from small number of large emitters that OGI can detect under most conditions
- ***Incorporate uncertainty in quantification using QOGI:*** Quantification is a challenging problem, yet estimates with high uncertainty better than no estimate