EEMDL
Energy Emissions Modeling and Data Lab

2025 EEMDL Annual Conference & Meeting
Poster Session

COLORADO SCHOOL OF MINES

Testing the Ergodic Assumption: Initial Findings from 2+ Years of Data from 27 Production Sites in the Appalachian Basin

ABSTRACT

The ergodic assumption (that a single unit's emissions over time has the same distribution as emissions of an entire population at a single time) is often implicit in oil and gas (O&G) methane emission inventories and sampling strategies. However, in practice this assumption remains untested. This study leverages over two years of continuous monitoring system (CMS) methane measurement data from 27 O&G production sites in the Appalachian Basin to evaluate the ergodic assumption. We characterize and compare emission rate distributions across different classes of operational equipment and find that sites with similar equipment seem to have different emission distributions, suggesting that operational factors may be a strong driver of emission profiles and that the ergodic assumption might not hold on the equipment level.

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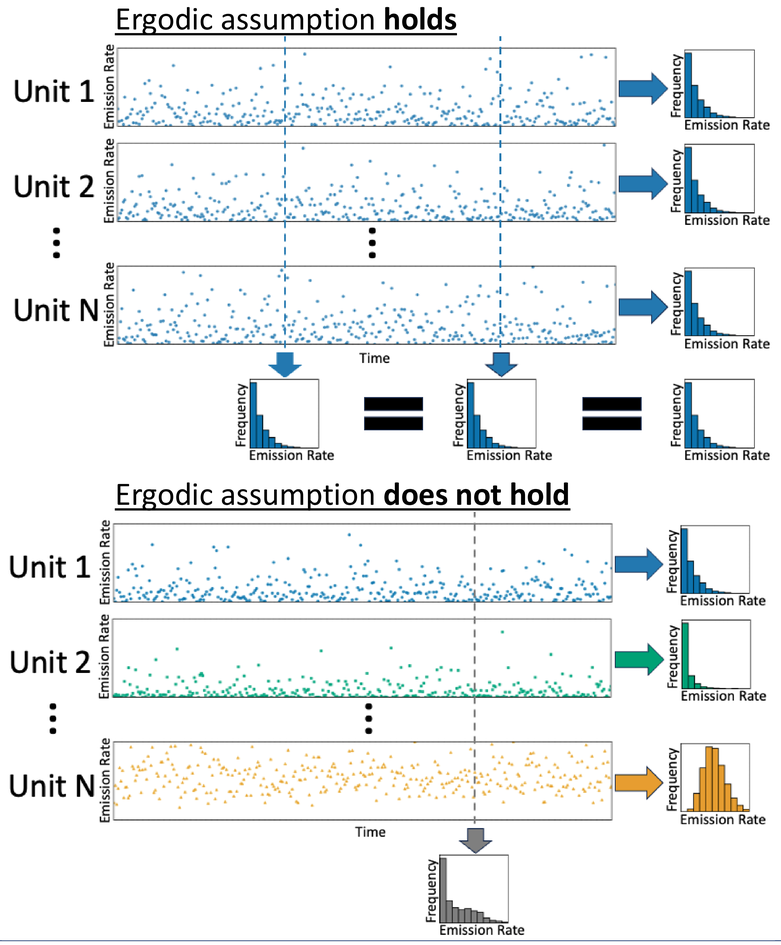
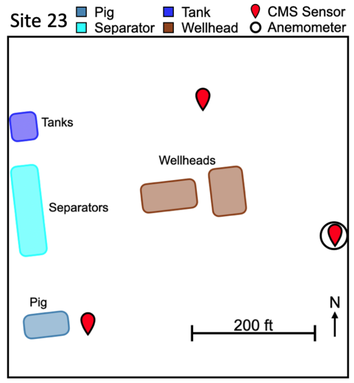
1. Background & Objectives

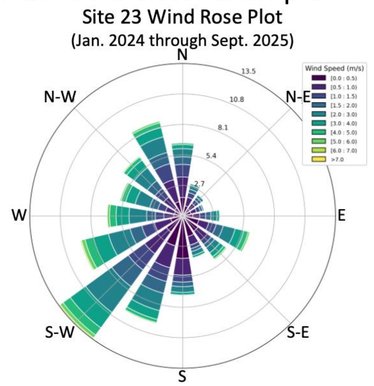
- A selection of 27 oil and gas production sites in the Appalachian basin are instrumented with CMS sensors .
- **Goal:** Determine if the ergodic assumption holds at the equipment-level across the Appalachian Basin. Results have implications for sampling frequencies and inventory estimation strategies at the equipment and site level.



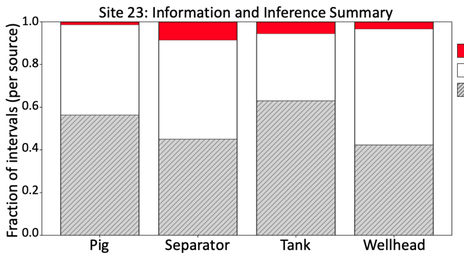
2. Methodology

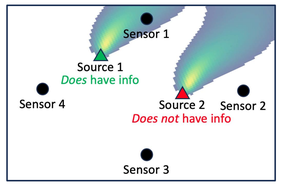
- Gather CMS data from all 27 O&G sites. Example:



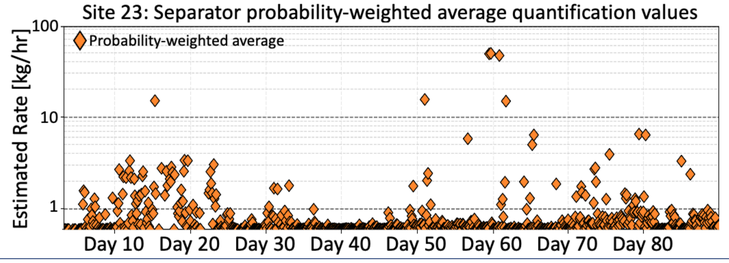


- Apply the Mines MDLQ algorithm to the CMS concentration data, omitting "no information" periods when the methane signal is not visible due to wind blowing between sensors.



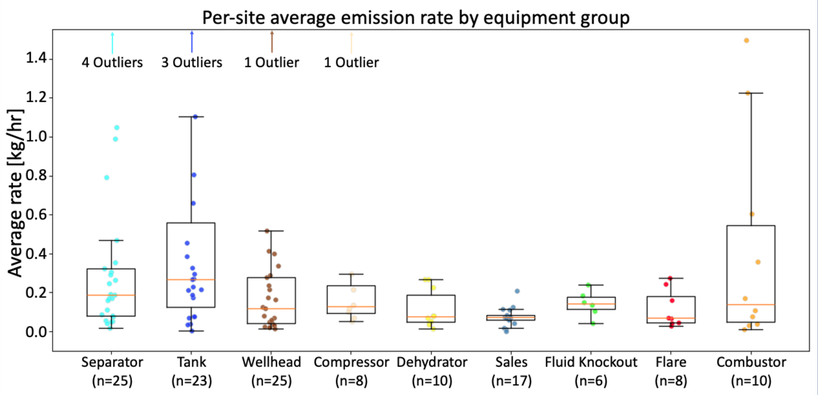


- Take a weighted average of quantification estimates by their probabilities of emitting.



3. Results

- We find that equipment-level emissions distributions vary across sites in the same basin, suggesting that operational factors cause a significant difference in the equipment-level emissions distributions.



- Tanks and Separators have the most variability in emissions, followed by Wellheads and Combustors.
- Other equipment (e.g. Sales) have similar emissions distributions across sites, suggesting the ergodic assumption may hold for these equipment groups.
- Combustors have more variable emissions than Flares.

4. Next Steps

- Ensure emissions distributions are being calculated in an unbiased way in light of no-information periods (see other poster).
- Conduct robust statistical tests of the ergodic assumption for each equipment group.
- Investigate the ergodic assumption across facilities.

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