



Title: Estimating methane emission durations using continuous monitoring systems

ABSTRACT

Updates to the EPA's Greenhouse Gas Reporting Program (GHGRP) require oil and gas operators to report detected methane emissions greater than 100 kg/hr starting in January 2025. A duration estimate is required for all emissions exceeding the 100 kg/hr reporting threshold so that a total mass of methane can be computed and reported under the EPA rule. Snapshot measurements (e.g., from a plane or satellite) taken infrequently have limited ability to characterize emission durations due to long gaps between subsequent observations of a given source. Continuous monitoring systems (CMS) measure methane concentrations in near-real time and therefore provide a promising avenue for complementing snapshot measurement technologies by bounding the duration of detected emissions. However, CMS will not record concentration enhancements during an emission if wind blows emitted methane away from the sensors. We present a method for estimating emission durations using CMS that probabilistically accounts for these non-detect times. We show an evaluation of the method on controlled release data and apply it to a production oil and gas site in the Appalachian basin. We find that ignoring CMS non-detect times can result in dramatically underestimated durations, especially when only a small number of CMS sensors are installed on a given site (resulting in limited coverage) as is often the case in practice.

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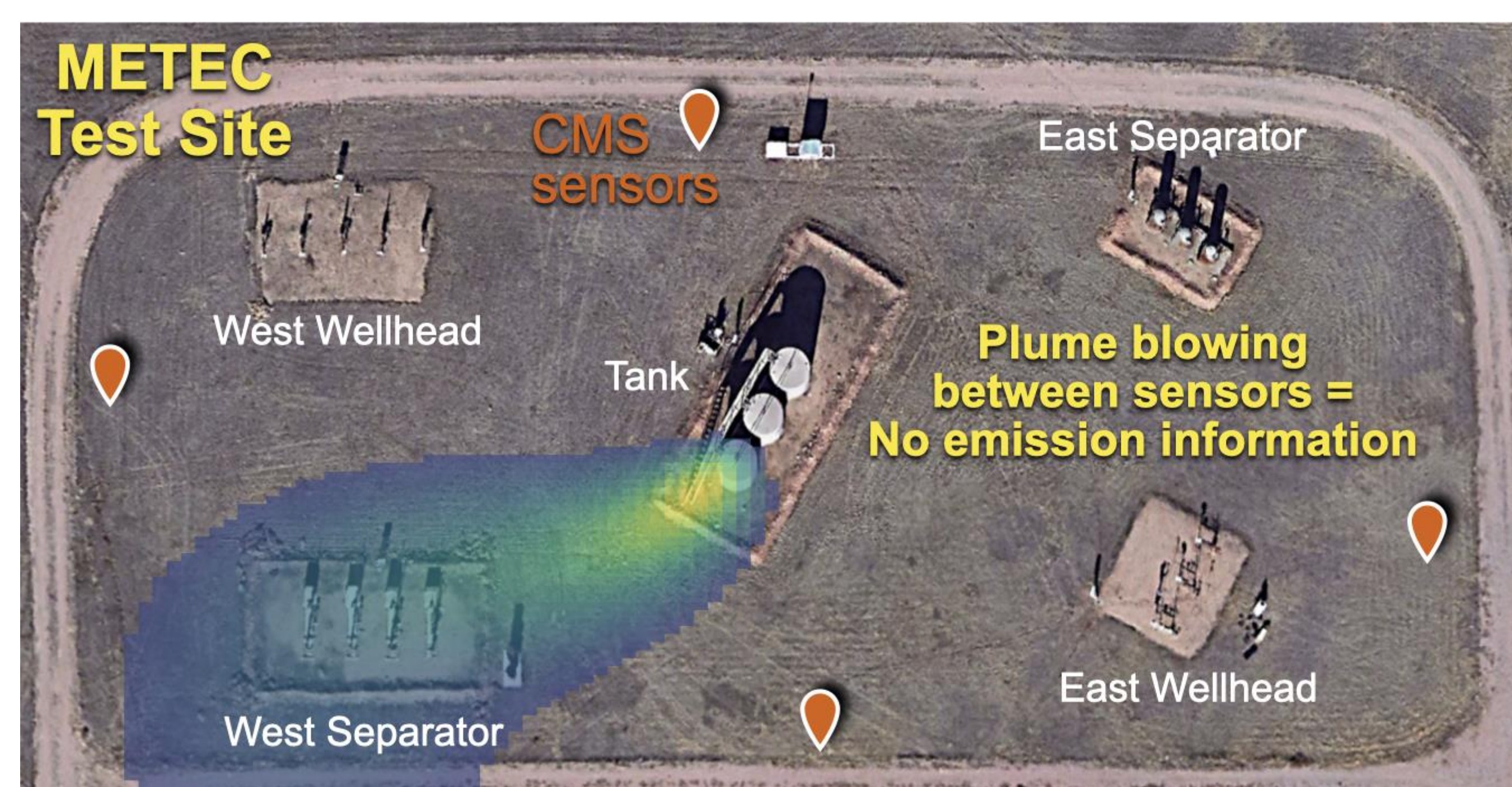
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1. Motivation

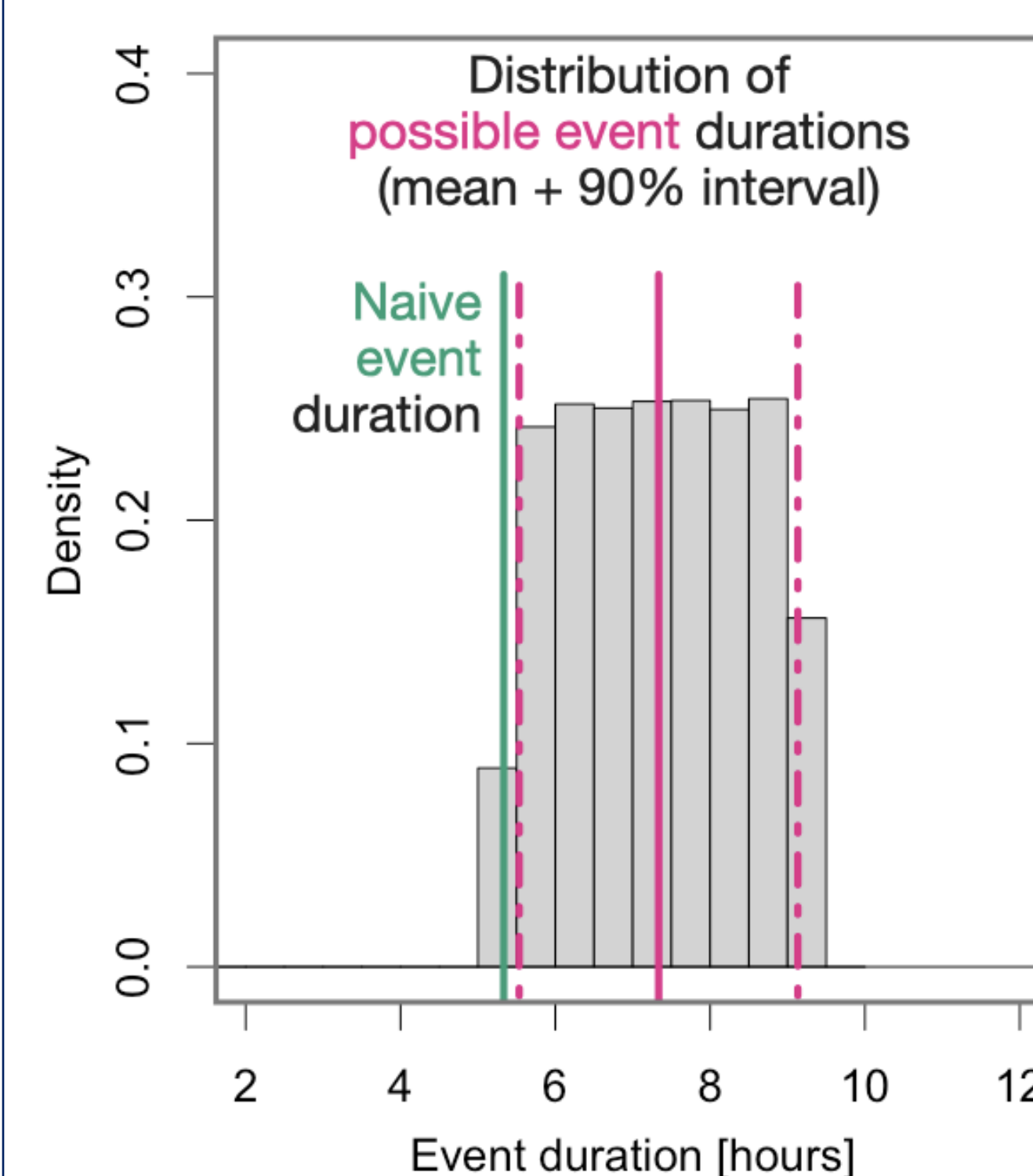
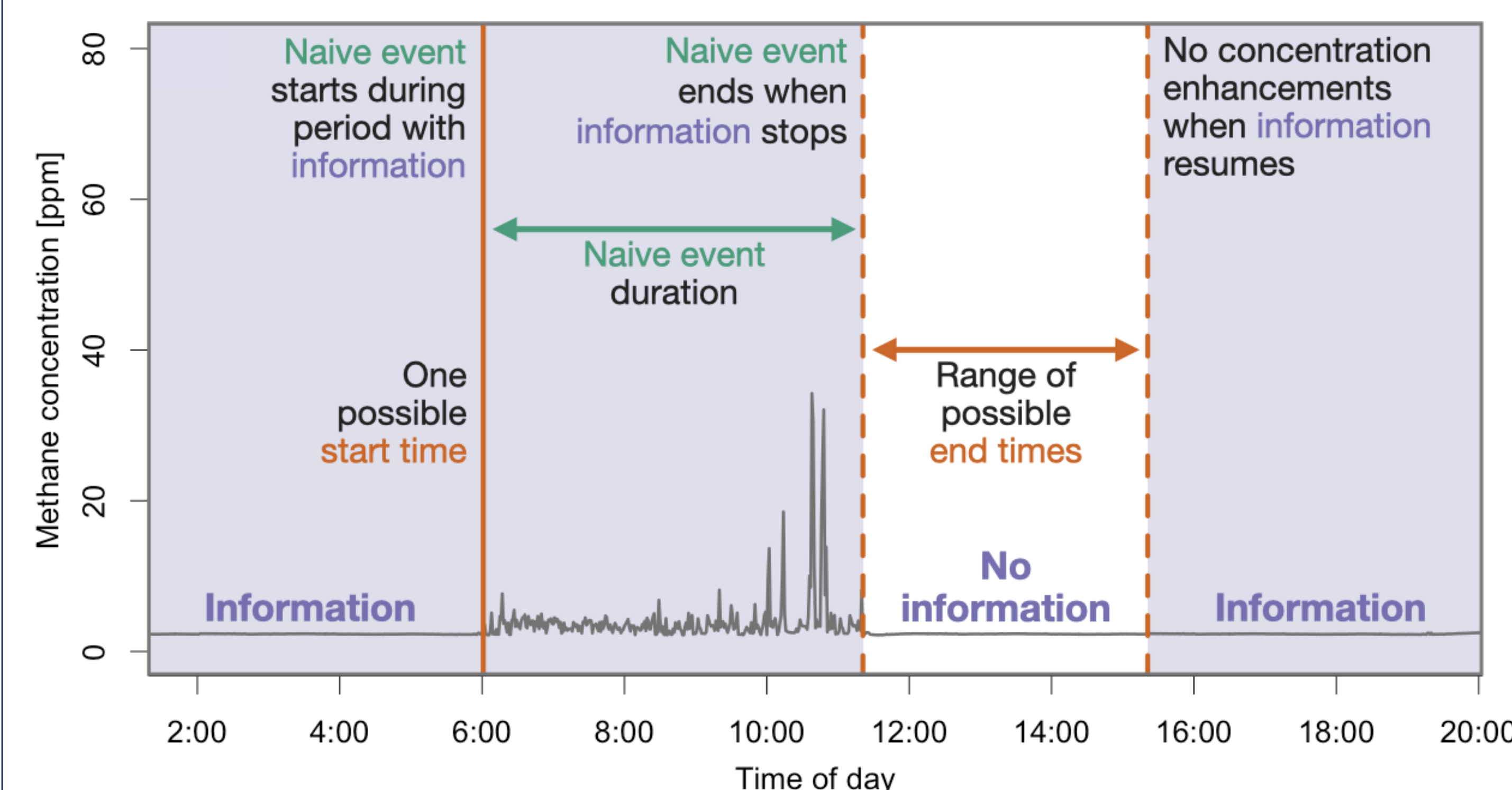
- Updates to the EPA's GHGRP Subpart W come into effect in January 2025, including a requirement to report all detected emission events > 100 kg/hr.
- Estimating the duration of these events is critical, as the total emitted mass of methane is highly influenced by the length of the emission.
- Infrequent sampling campaigns can roughly bound duration, but the fidelity of the duration estimate is limited by the sampling frequency.

2. Background



- Continuous monitoring systems (CMS) measure methane concentrations in near real time and can complement snapshot measurements.
- However, gaps in information can make it appear that emissions start late or end early.

3. Methods



- Use atmospheric dispersion model to identify periods of information and no information.
- Account for gaps in information when sampling emission start and end times.

- Assign a probability of combining events that are separated by periods of no information.

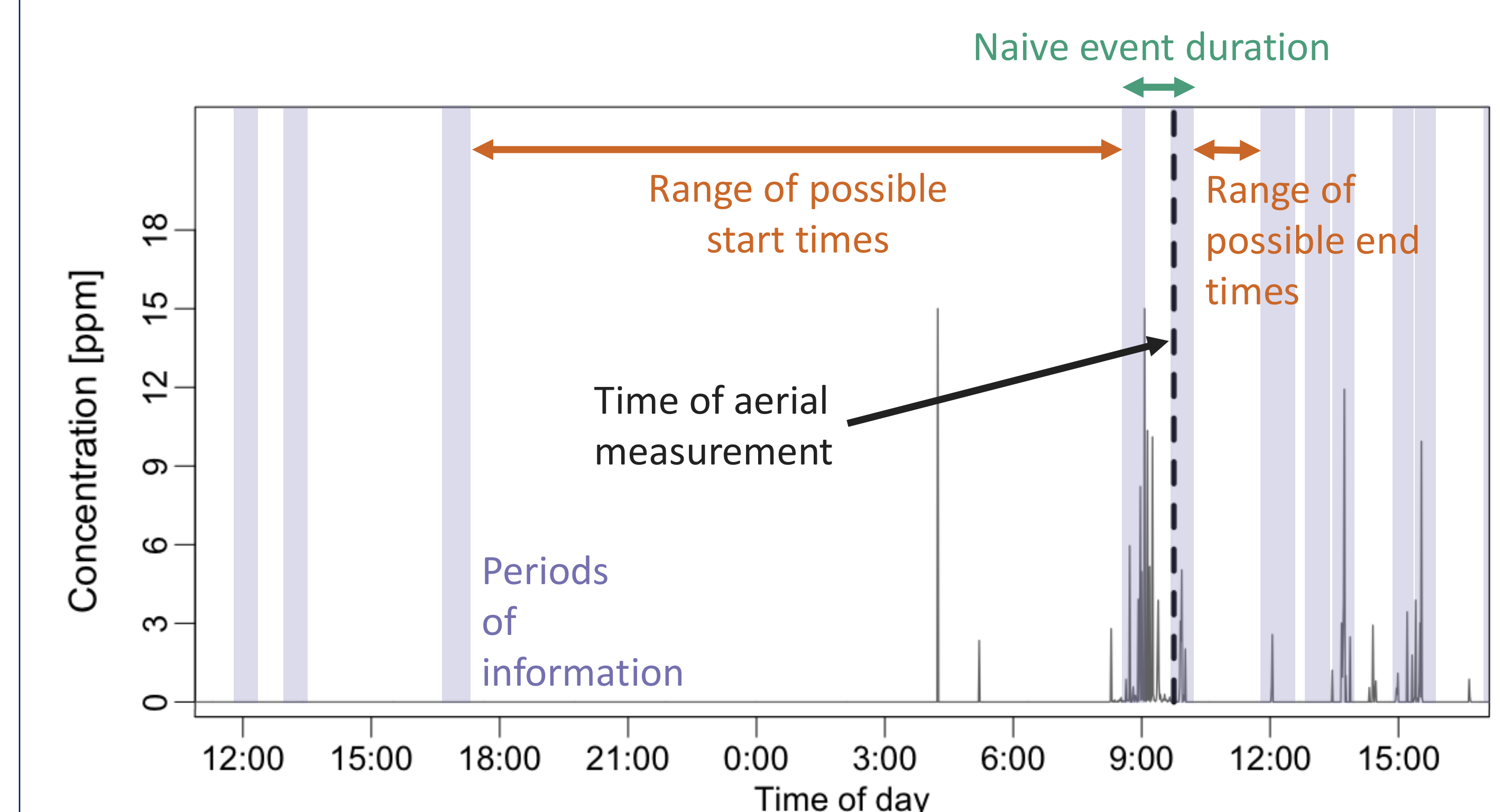
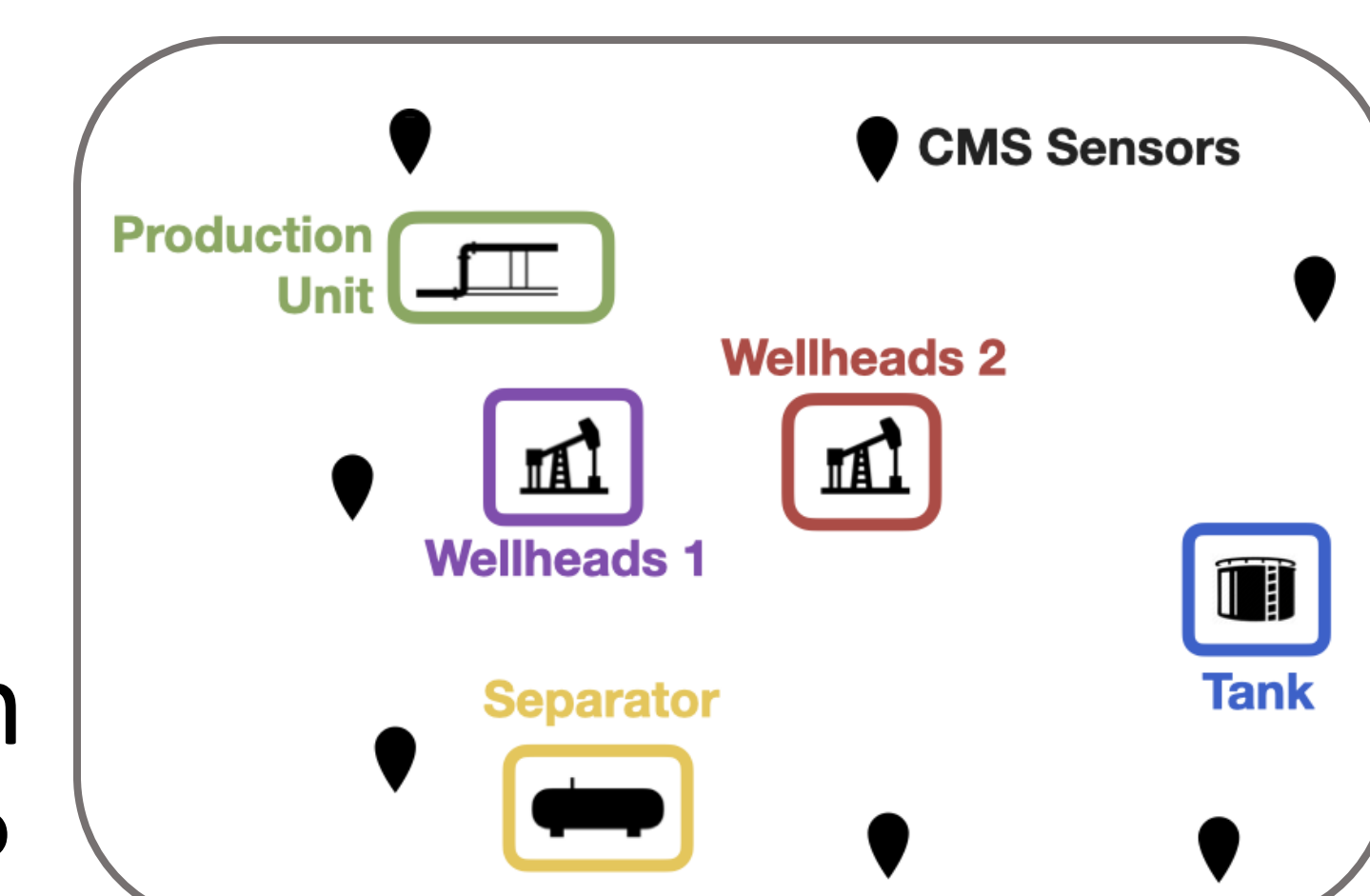
5. Conclusions

1. CMS can complement snapshot measurement techniques by bounding emission durations.
2. Accurate duration estimates from CMS require a method for addressing non-detect times.

4. Results

- Duration model evaluated on controlled releases. Slight tendency to underestimate (bias of -5%), with 87% of estimates within a factor of 2x error.

- Case study: Snapshot measurement of 9.6 kg/hr from the tanks. Can we use CMS data to bound the duration of this measurement?



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|------------------------|---|---|---|-----------------------|
| 9.6 kg/hr | X | naive duration: 1.78 hours | = | 17.1 kg |
| | | mean of possible durations: 10.2 hours | | 97.9 kg |
| | | max of possible durations: 18.8 hours | | 180.5 kg |
| 9.6 kg/hr | X | time since previous aerial survey: 3 months | = | 21,024 kg |
| Detected emission rate | | Potential duration estimates | | Total emitted methane |