Comparison of Co-Located Laser and Metal Oxide Continuous Monitoring Systems

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Elements of an Emission Rate Estimate

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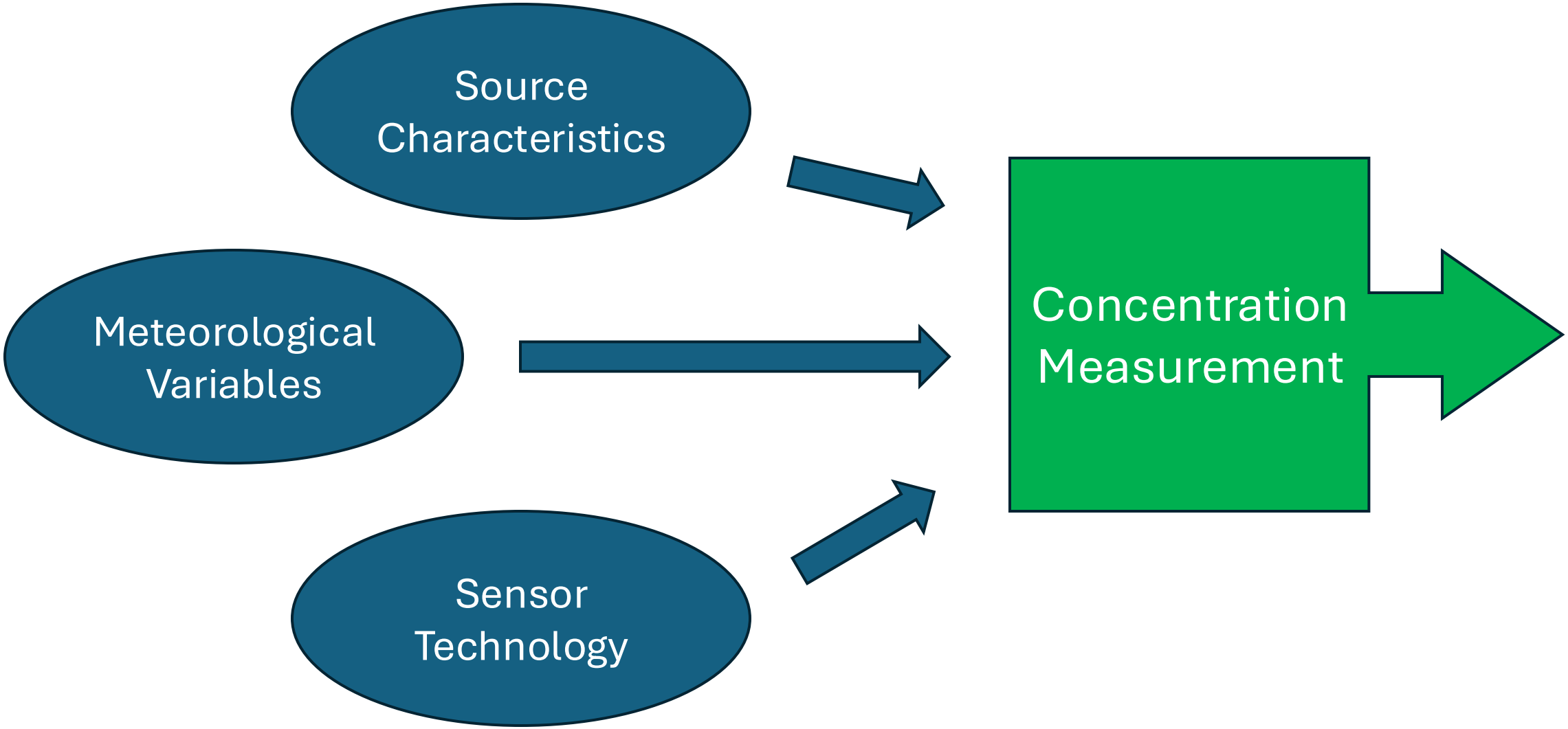
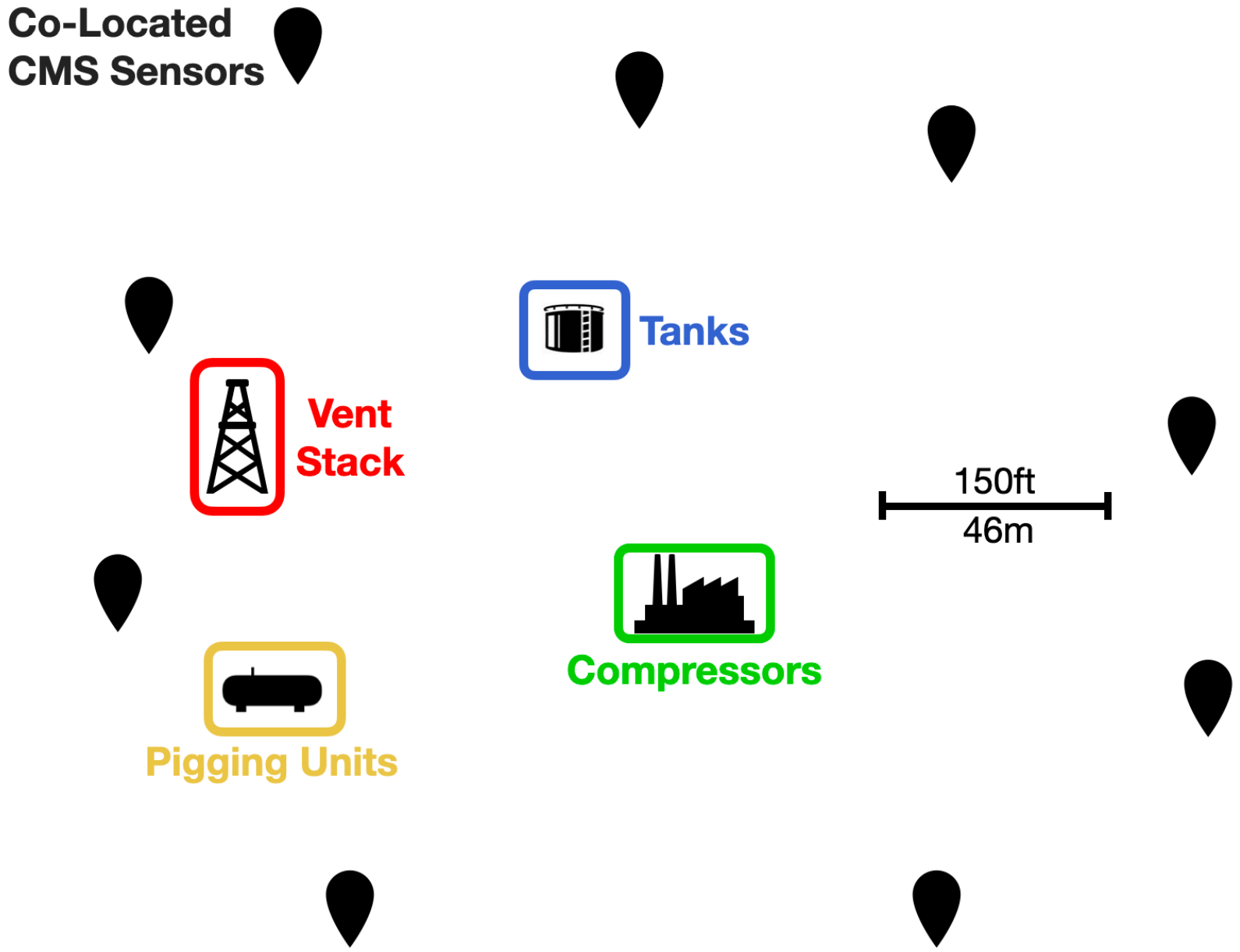
What Affect a Concentration Measurement?



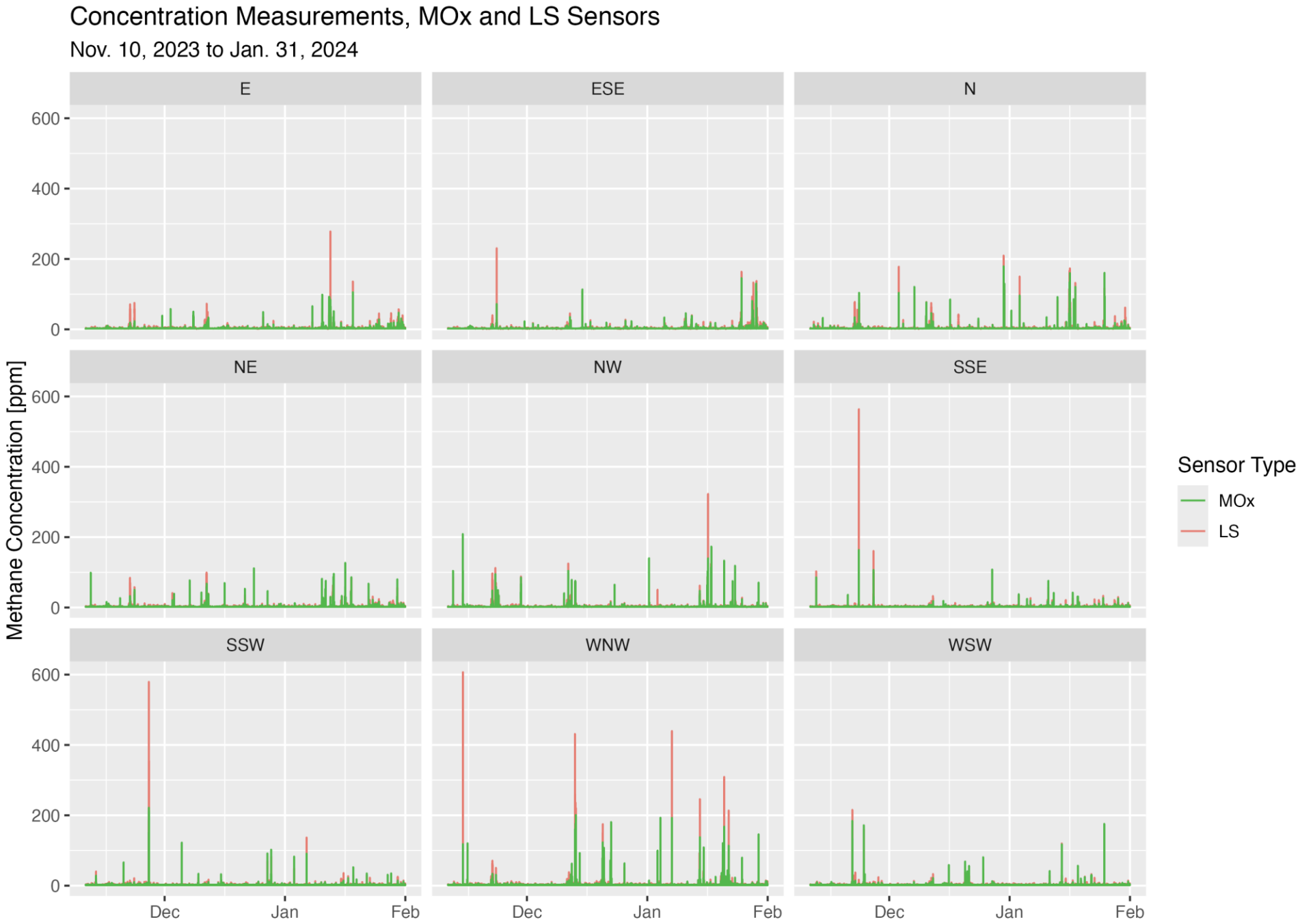
Operational Site

- 9 co-located Metal Oxide (MOx) and Laser Spectroscopy (LS) sensors
- MOx sensors detect changes in resistance across a metal oxide
- LS sensors use laser absorption



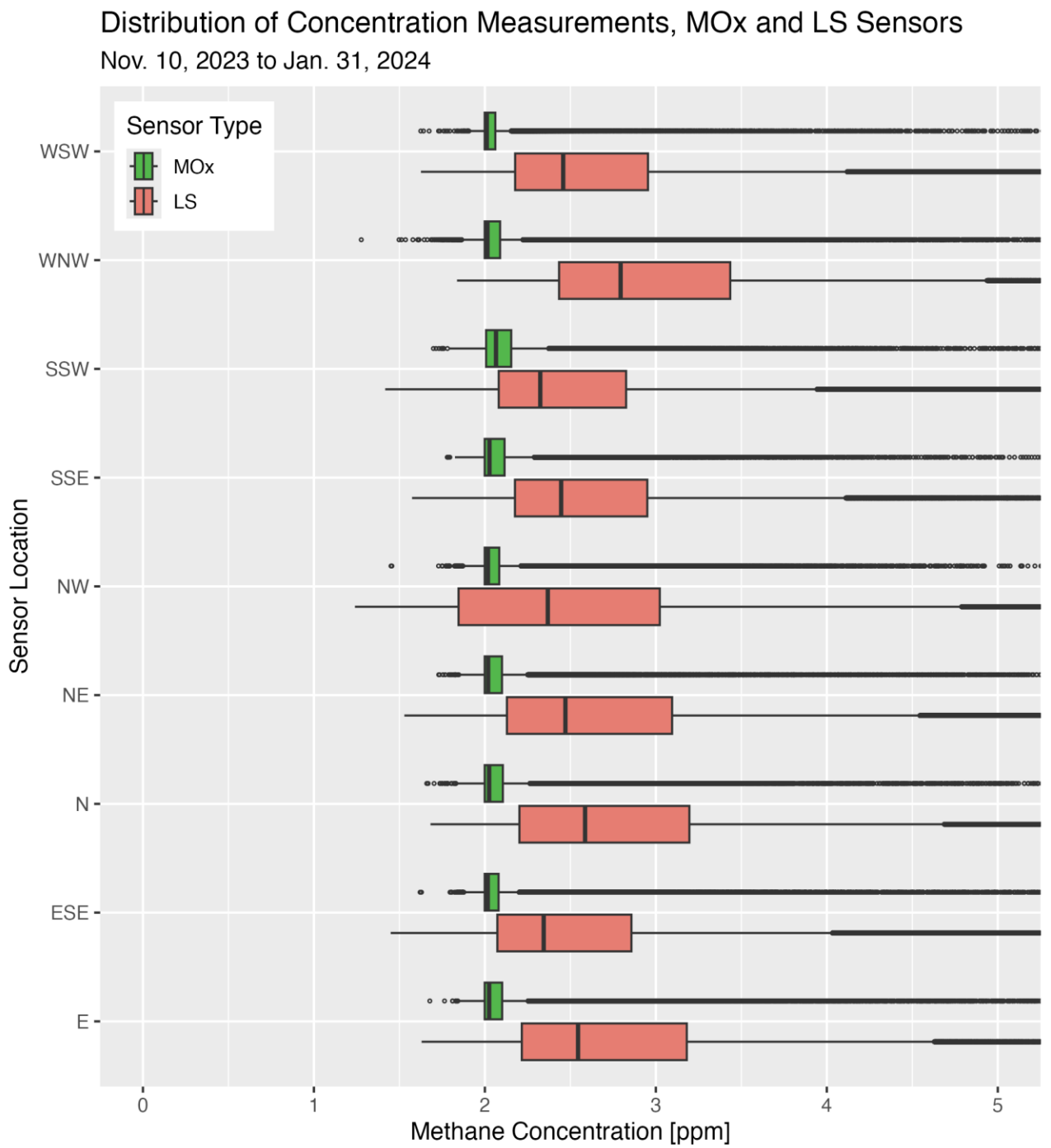
Exploratory Analysis

- MOx sensors are recording smaller maximum concentrations



Exploratory Analysis, Distributions

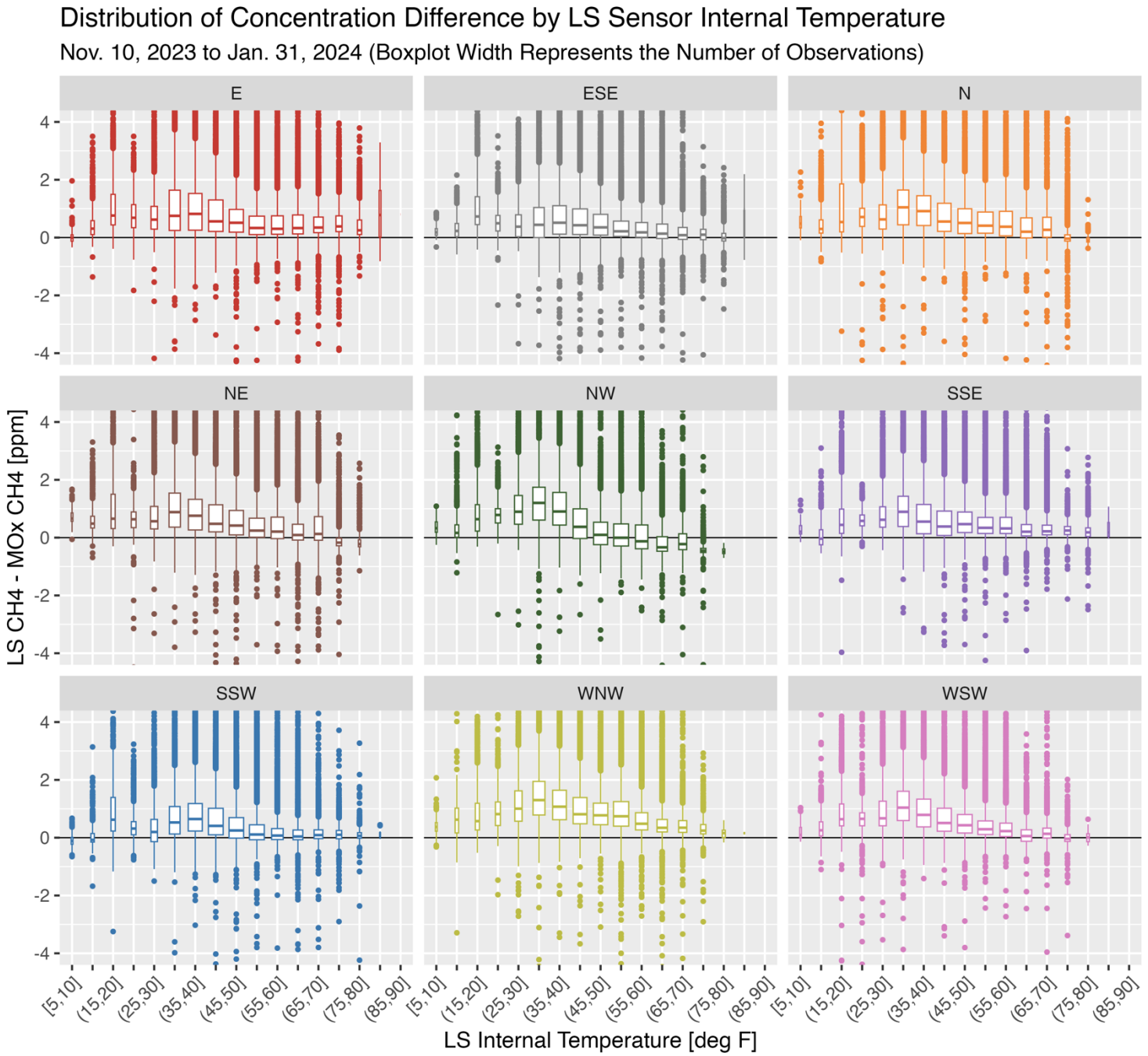
- LS sensors record larger, more variable concentrations
- The LS-NW sensor was recording erroneous concentrations below background level



Investigation of Meteorological Variables

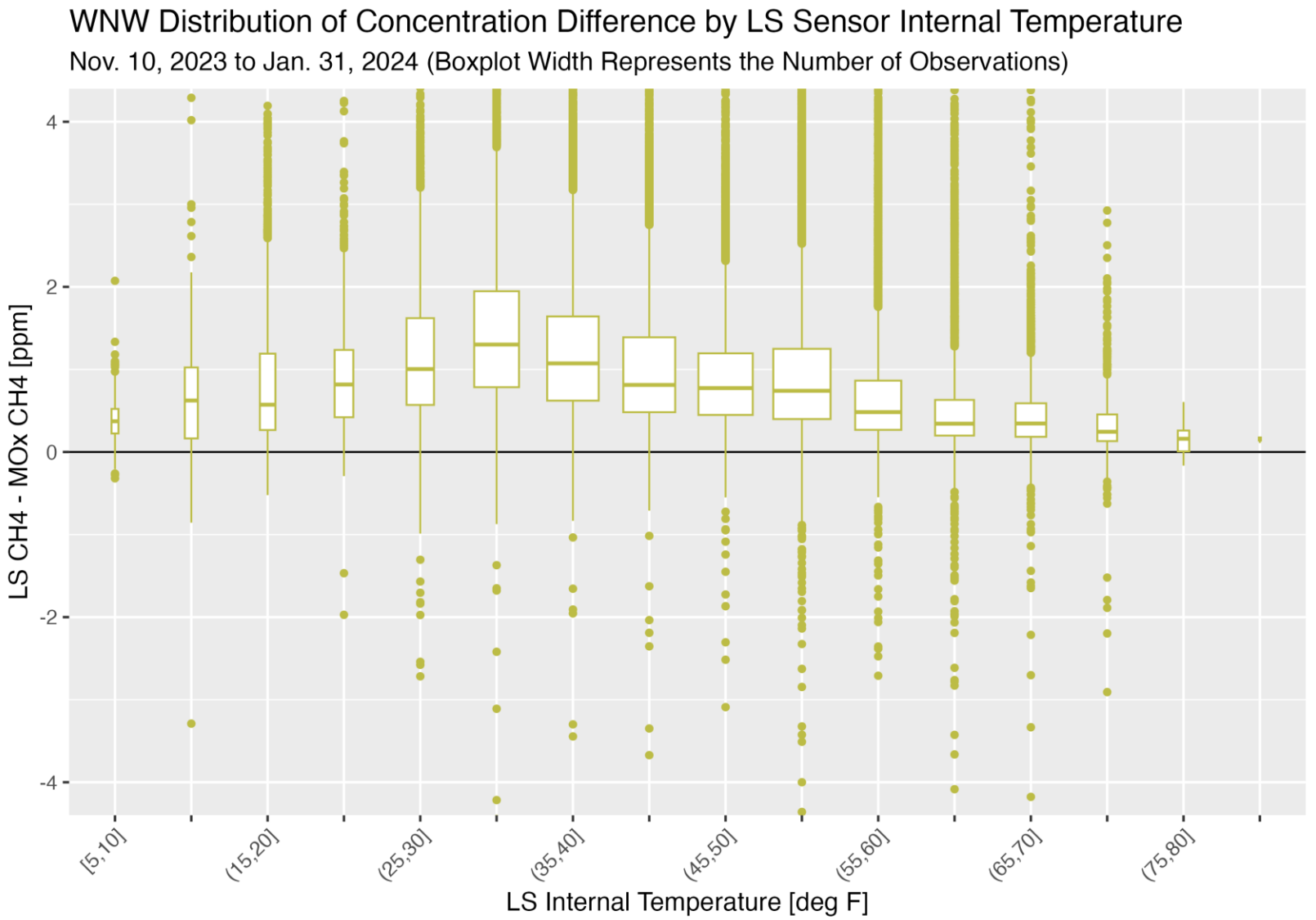
Temperature

- Width of boxplot represents number of observations
- Effect of temperature is similar across all sensors
- Difference is positive in general



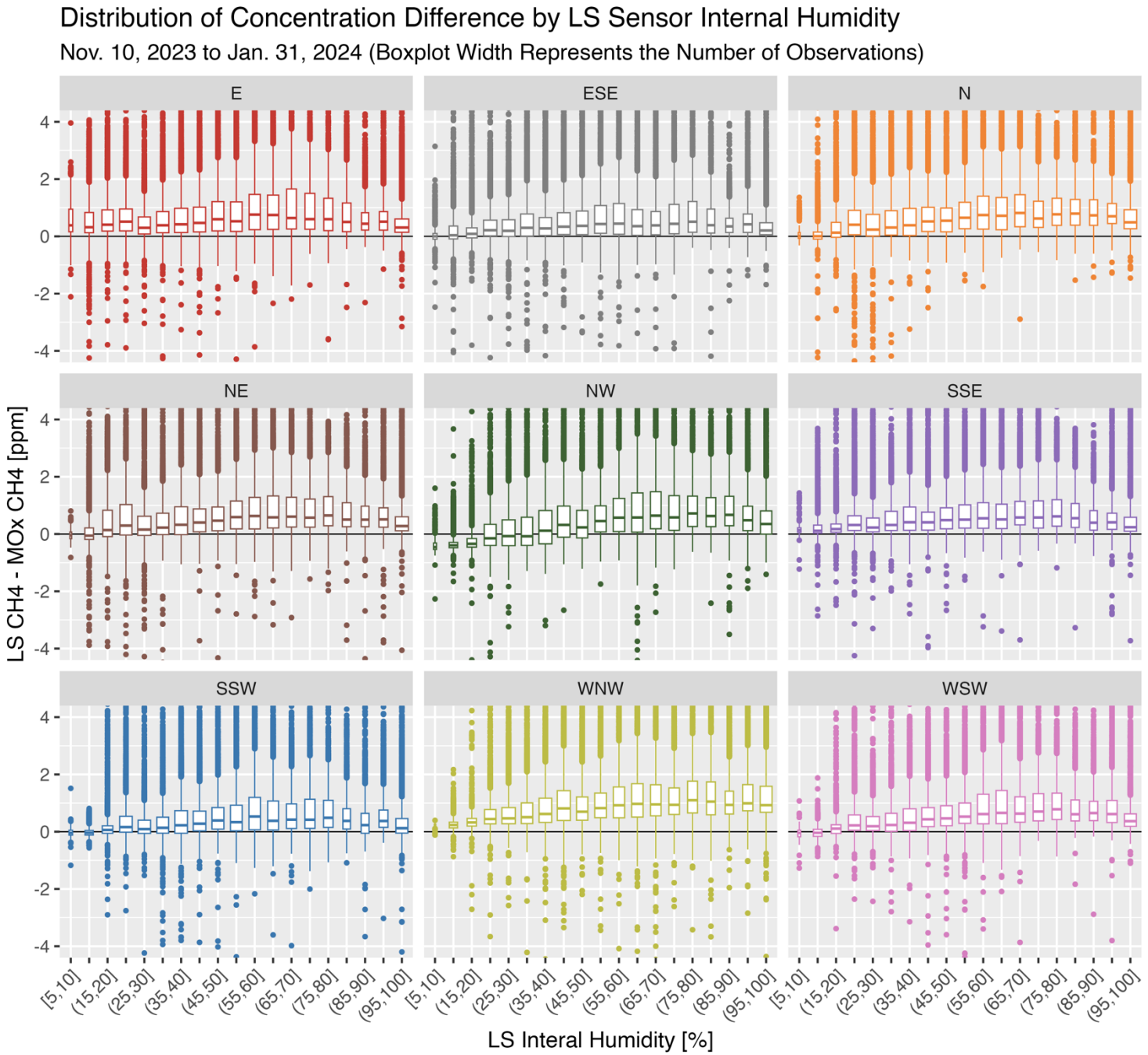
Temperature

- Greatest difference between 30 and 70 degrees



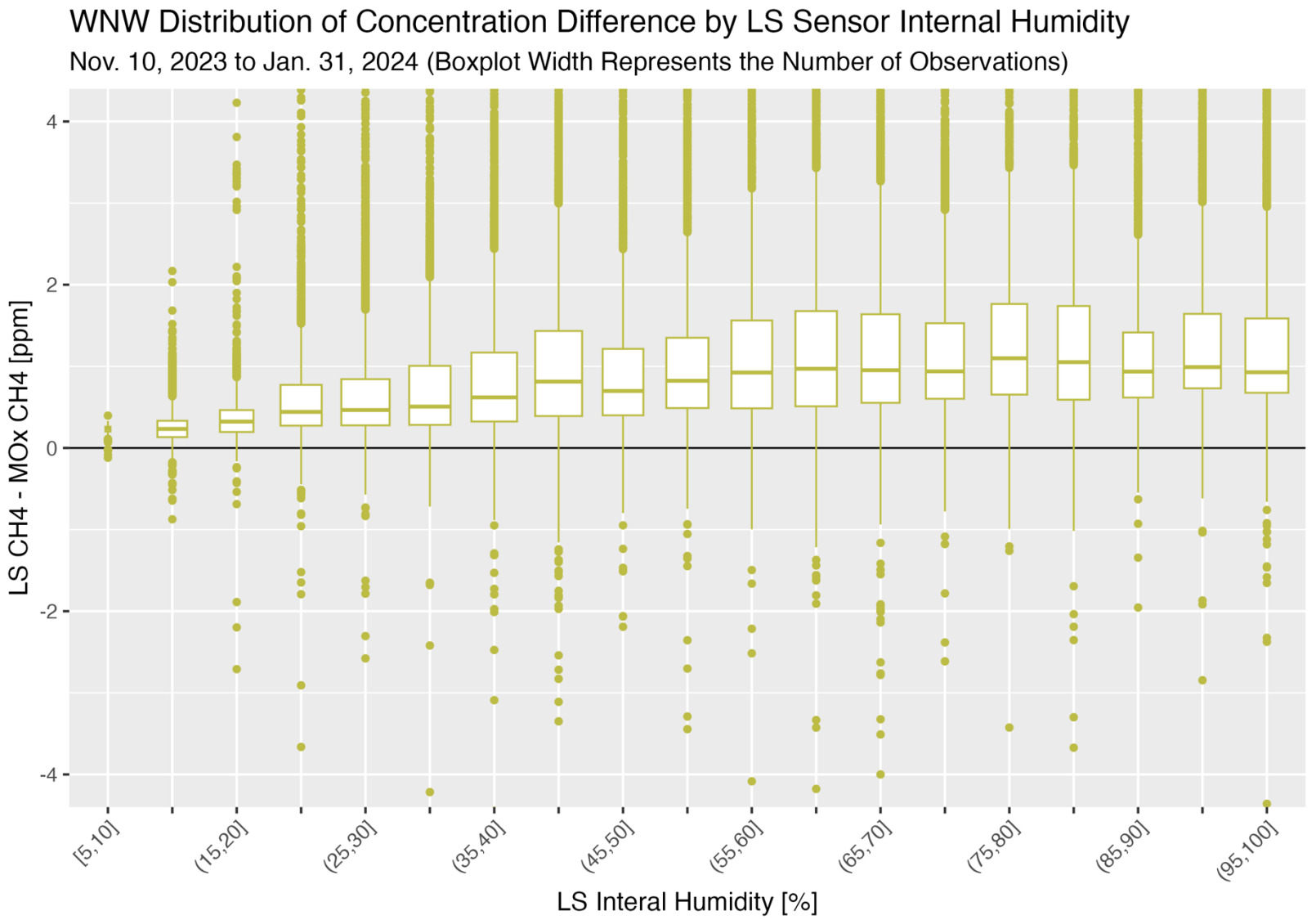
Humidity

- Positive differences in general
- Pattern is consistent across sensors



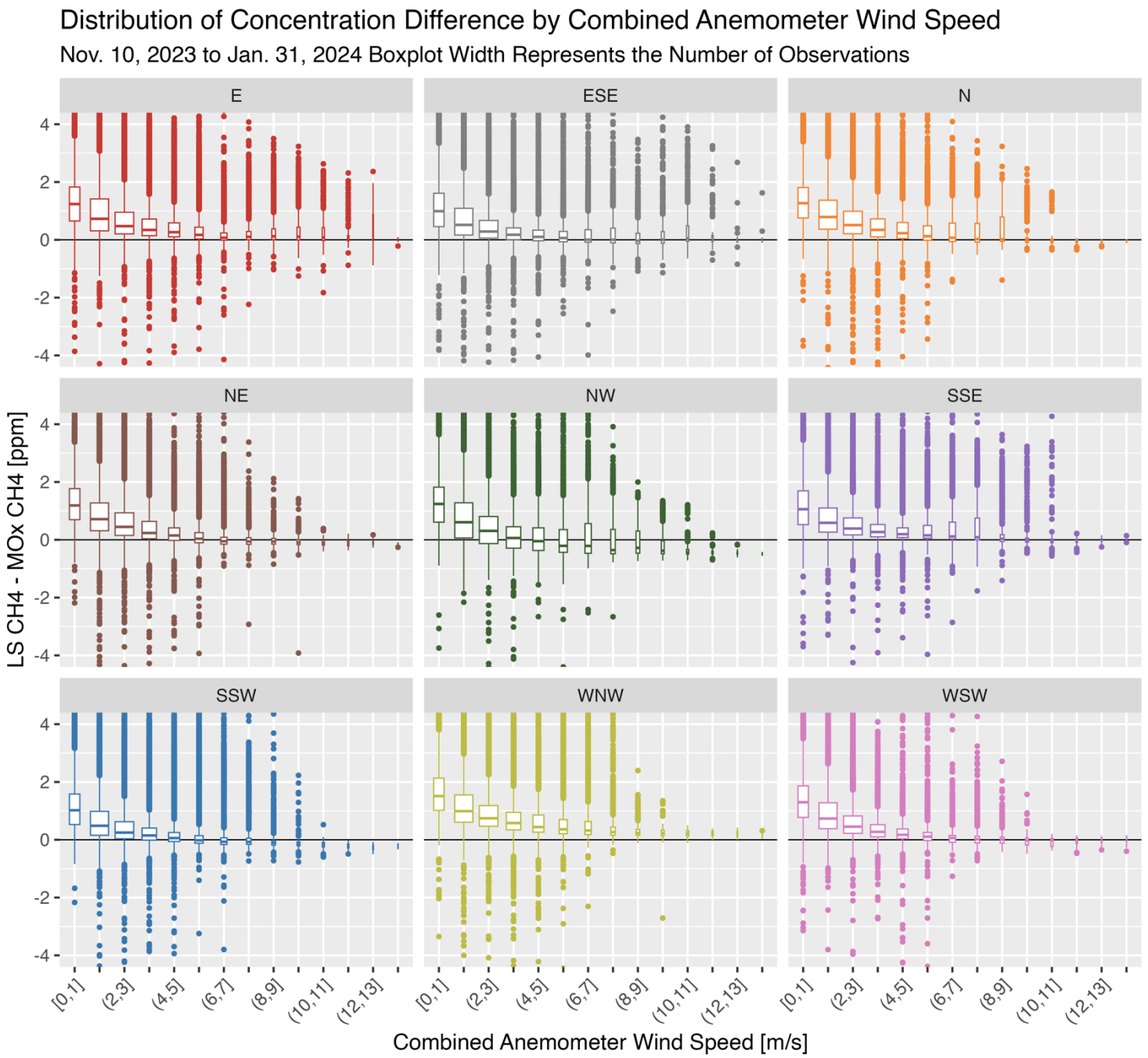
Humidity

- Differences increase as humidity increases



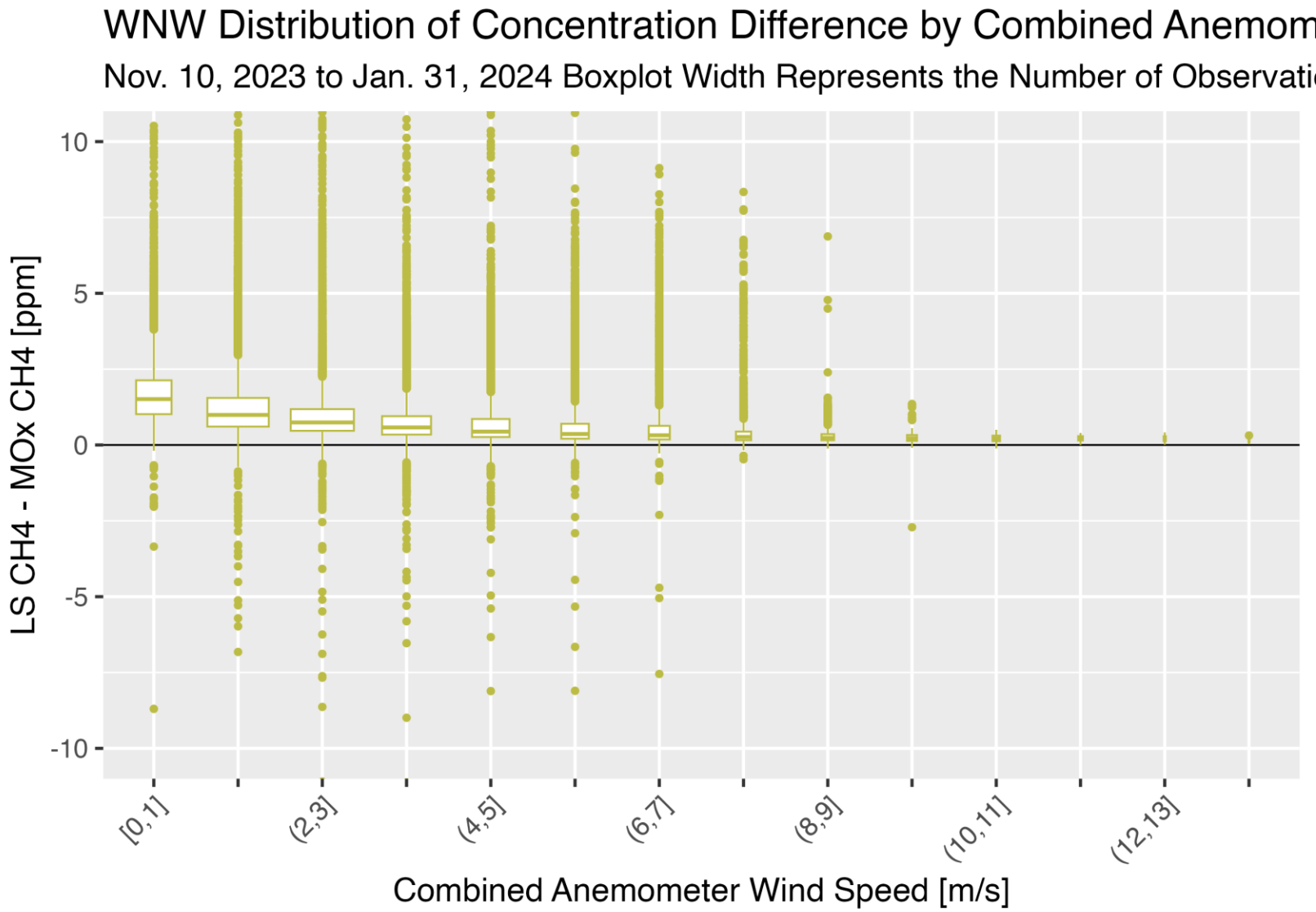
Wind Speed

- Differences are positive in general
- Trend is consistent across sensors



Wind Speed

- Difference decreases as wind speed increases
- Fewer observations at high wind speed



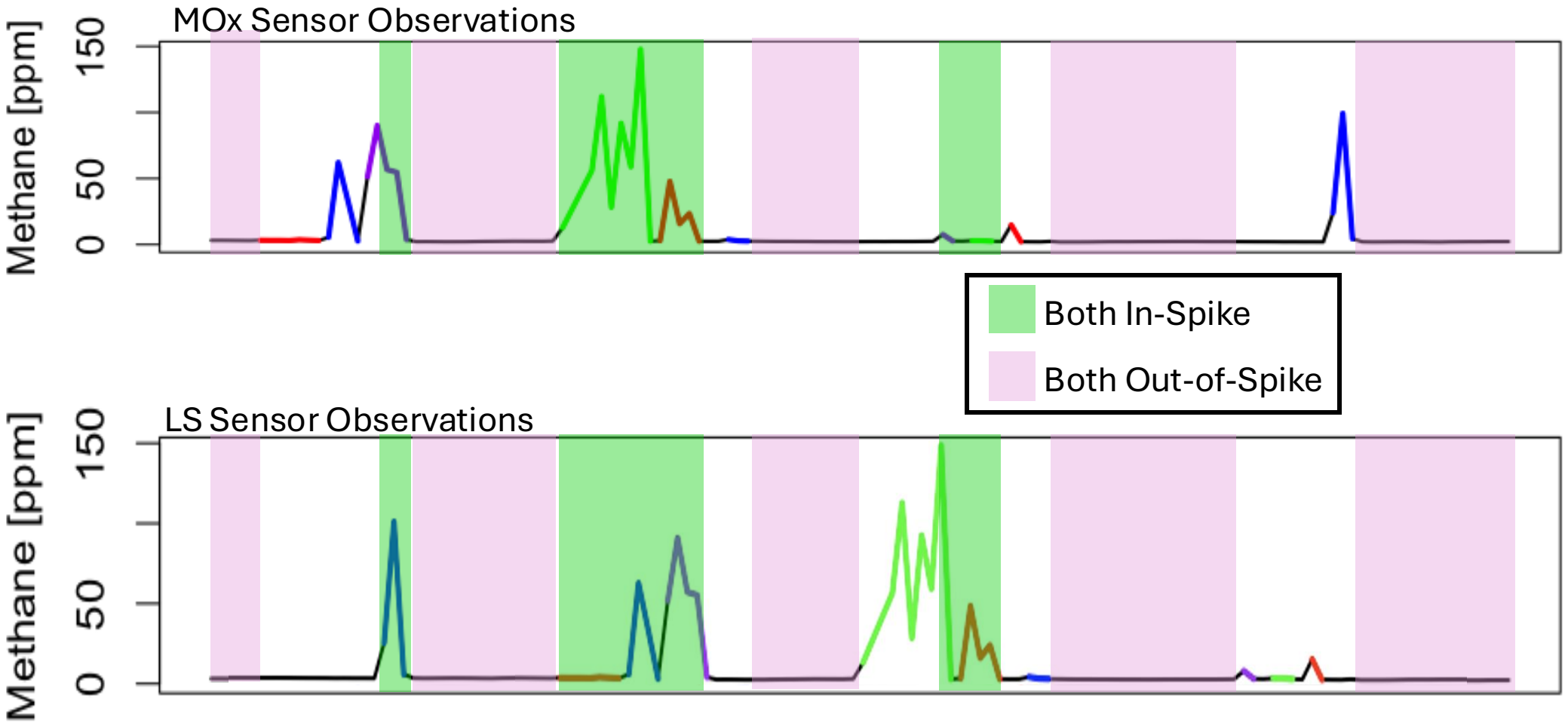
Conclusions so far

- Meteorological variables are affecting concentration measurements
- Differences are larger when…
  - Temperatures are between 30 and 70 degrees
  - Humidity is higher
  - Wind speed is slower

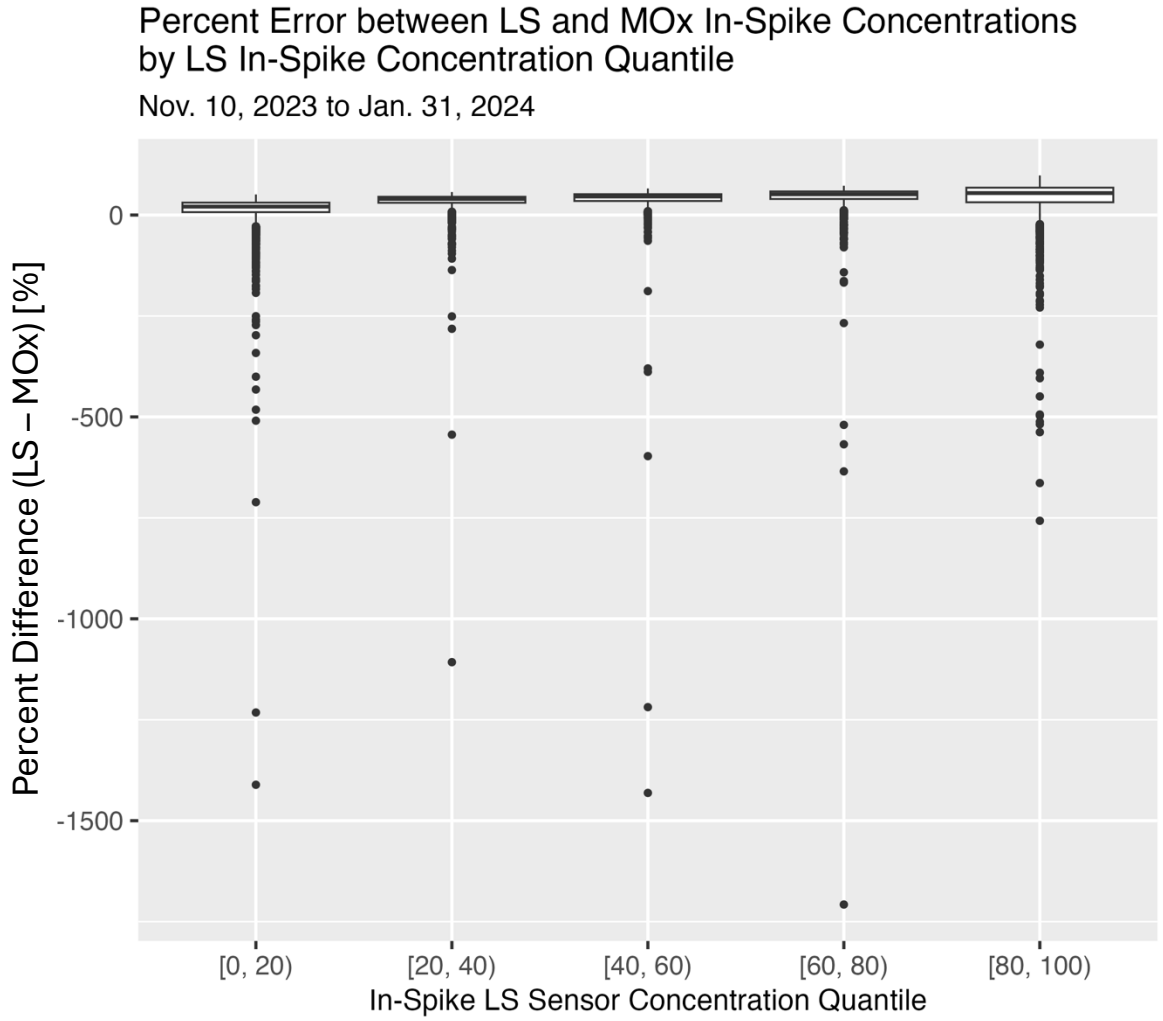
…and consistent across sensors

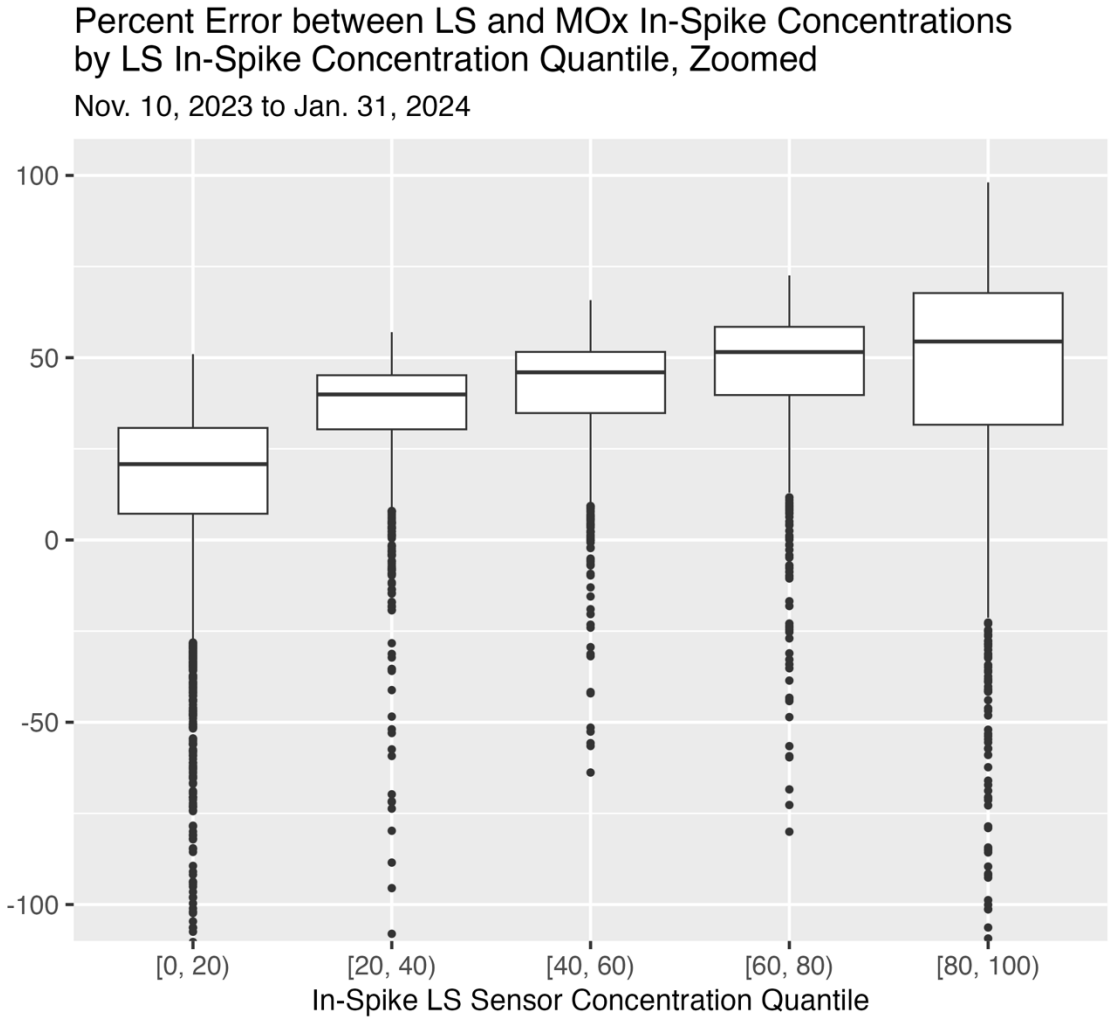
Differences during Concentration Enhancements

Alignment of In/Out of Spike Periods



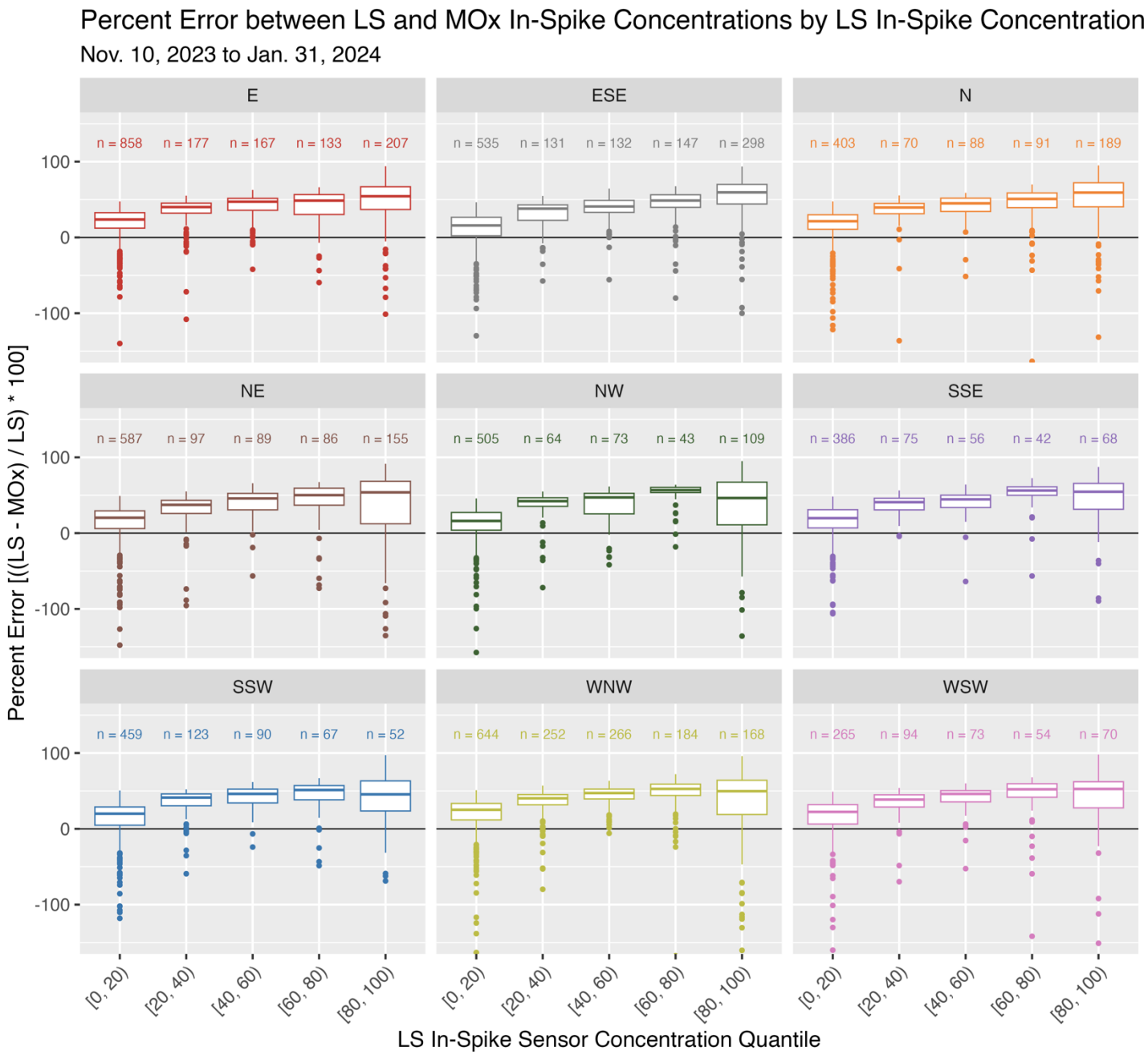
In-Spike Percent Error



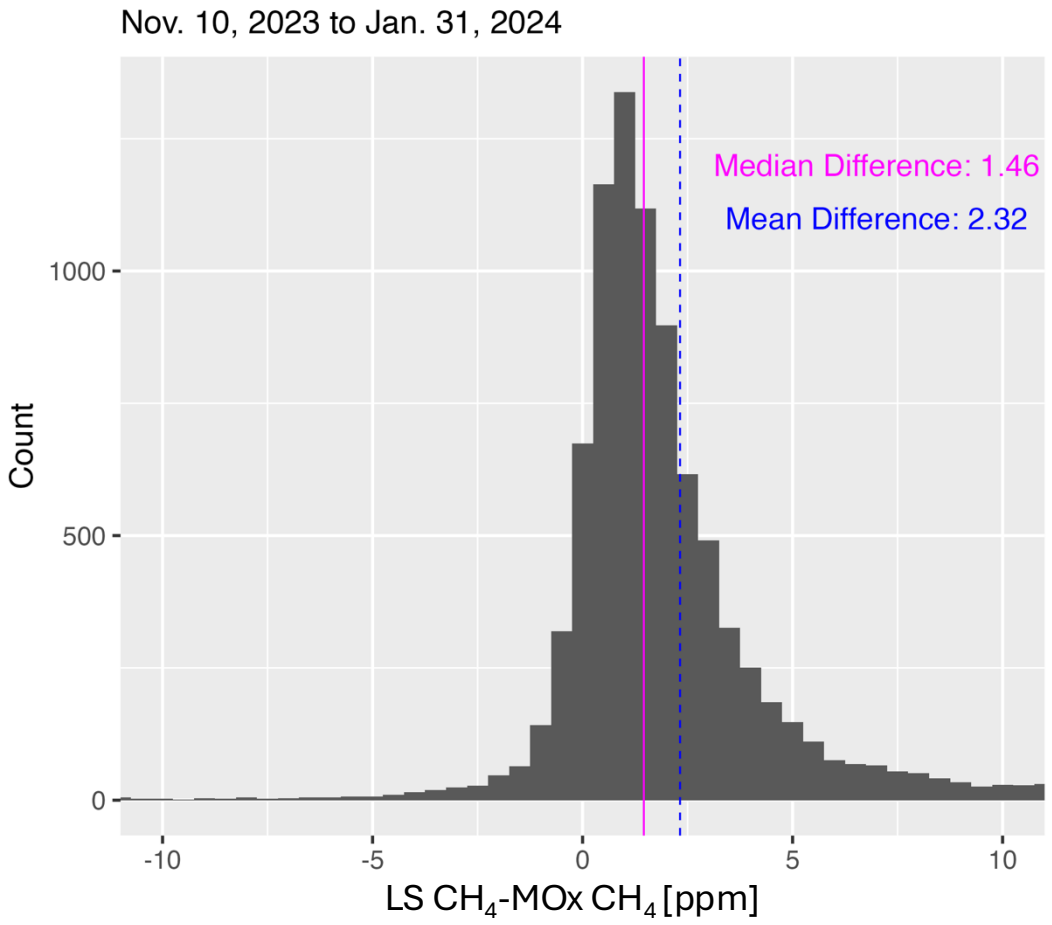


Previous results not driven by one sensor

- Percent differences are consistently positive
- This indicates that MOx sensors are recording smaller enhancements
- Consistent across all sensor groups
- Percent difference increases as LS in-spike concentration increases

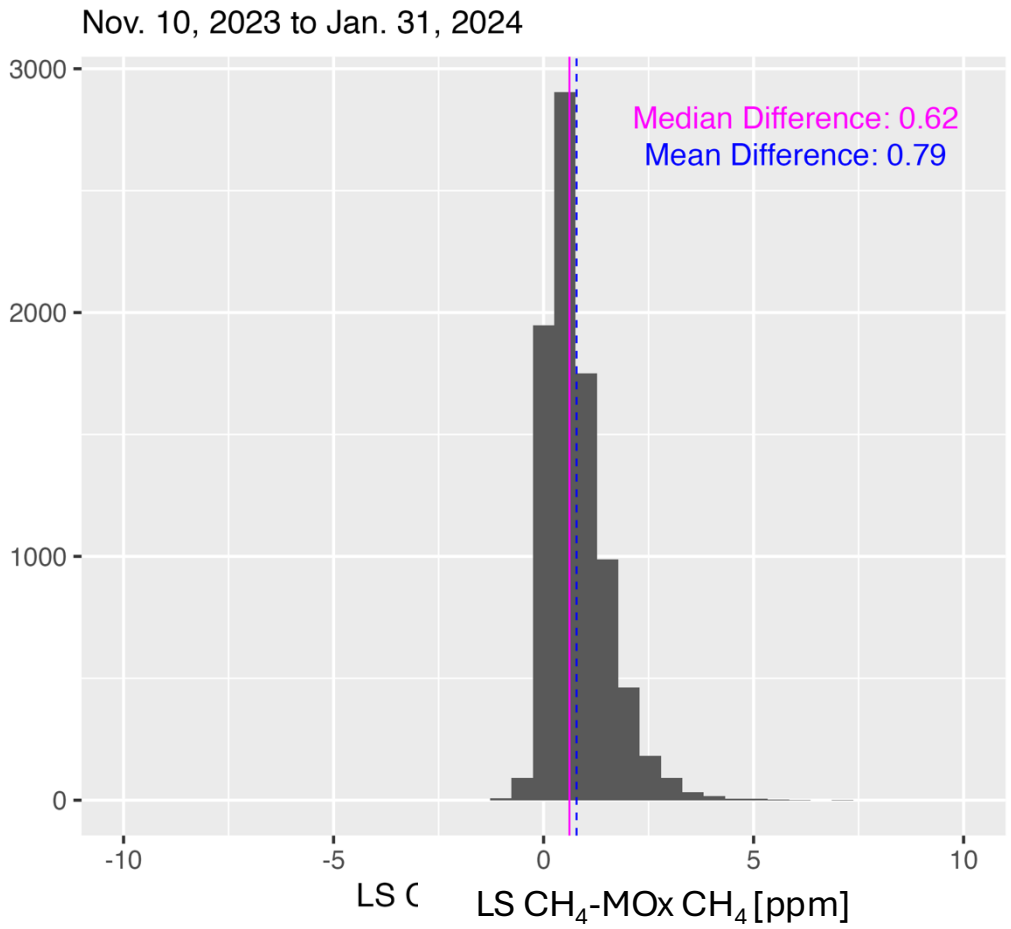


Both Sensors In-Spike



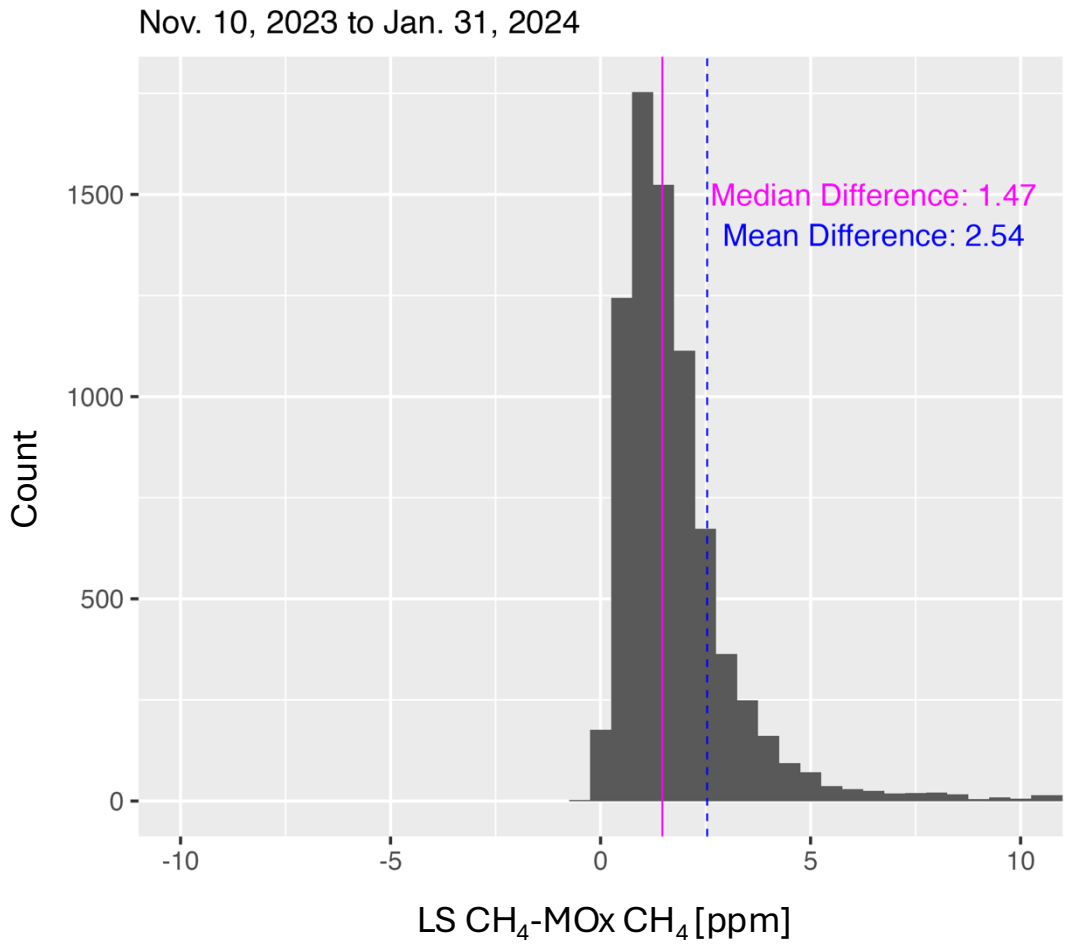
Encapsulates **2.82%** of all observations

Both Sensors Out-of-Spike



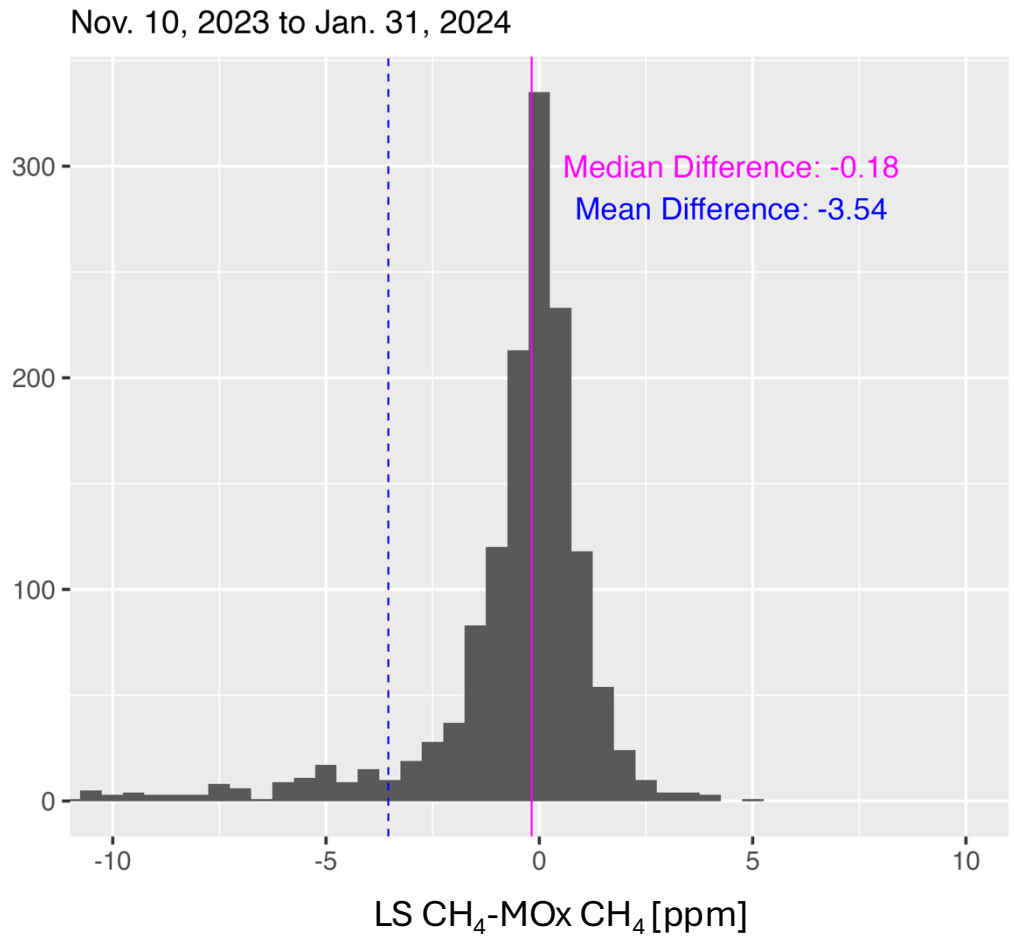
Encapsulates **87.24%** of all observations

Only LS Sensor In-Spike



Encapsulates **9.70%** of all observations

Only MOx Sensor In-Spike



Encapsulates **0.25%** of all observations

Additional Conclusions

- In-spike concentrations differ
- Differences increase with in-spike concentration
- LS sensors record spikes MOx sensors do not…
- …the opposite is rarely true

Thank you! Questions?

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