Quantifying and Comparing Air Pollution Near the Fairbanks International Airport and Downtown

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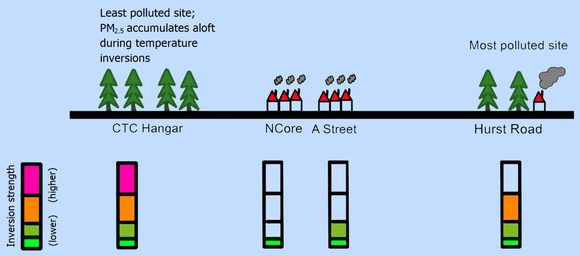
Abstract



Fine particulate matter impacts human and environmental health. This study fills the knowledge gap of how pollution behaves near the Fairbanks International Airport. The airport region had the lowest 3m $PM_{2.5}$ concentrations out of four regions studied. At the airport region, $PM_{2.5}$ aggregated aloft rather than at 3m during temperature inversions. Inversion strengths differed between all sites, however start and end times of inverted periods were similar.

Methods

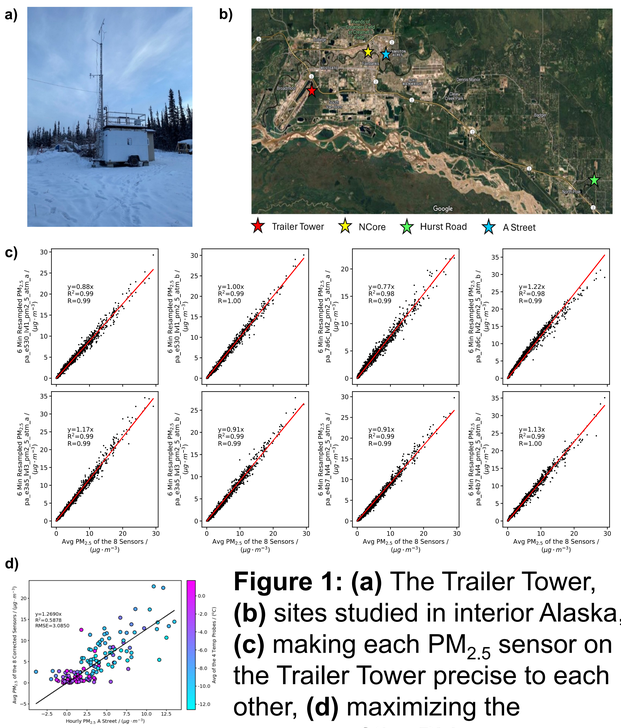


Figure 1: (a) The Trailer Tower, **(b)** sites studied in interior Alaska, **(c)** making each $PM_{2.5}$ sensor on the Trailer Tower precise to each other, **(d)** maximizing the accuracy of the $PM_{2.5}$ sensors.

Results

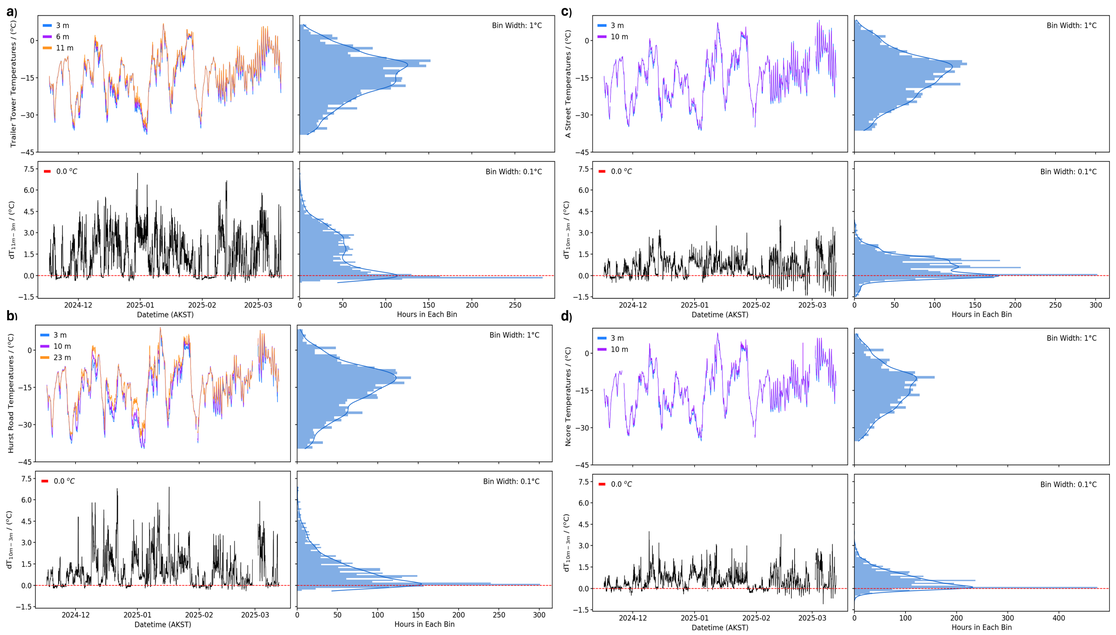


Figure 3: Hourly resampled temperatures and inversion strengths at **(a)** Trailer Tower **(b)** Hurst Road **(c)** A Street **(d)** Ncore from 11/16/24 14:00 AKST to 3/13/25 00:00 AKST. The Trailer Tower was parked in front of the CTC Hangar during this time. Hurst Road, A Street, and Ncore are the Alaska DEC's air quality monitoring sites. The top histogram of each subplot depicts each site's 3m temperature distribution. KDE plots are overlaid onto each respective histogram.

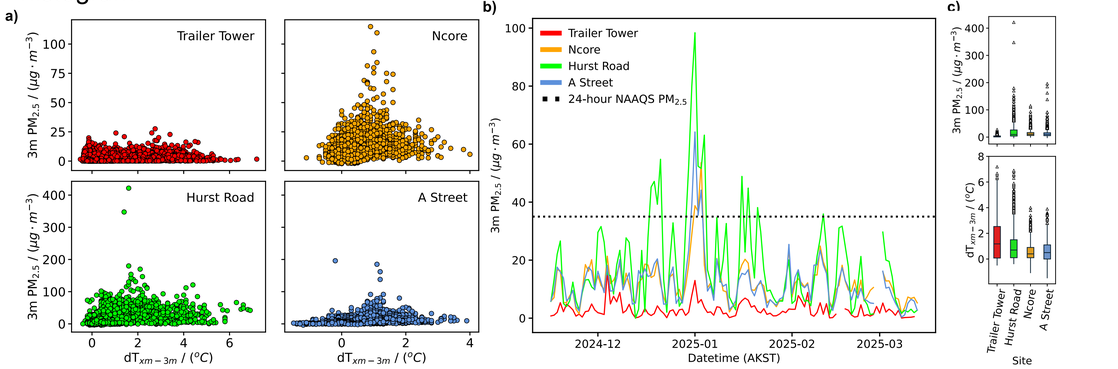


Figure 4: (a) Hourly resampled 3m $PM_{2.5}$ versus hourly resampled temperature differences between 11m and 3m for the Trailer Tower and 10m and 3m for the three DEC sites from 11/16/24 14:00 AKST to 3/13/25 00:00 AKST. **(b)** 24-hour resampled 3m $PM_{2.5}$ at all sites from 11/16/24 00:00 AKST to 3/13/25 00:00 AKST. **(c)** Boxplot distributions of hourly resampled 3m $PM_{2.5}$ (top) and temperature differences (bottom) at all sites from 11/16/24 14:00 AKST to 3/13/25 00:00 AKST. The topmost temperature probe altitude, x, is the same as in subplot (a) where x=11m for the Trailer Tower and x=10m for the three DEC sites. All boxplot whiskers extend to the furthest data point within 1.5 times the interquartile range (IQR).

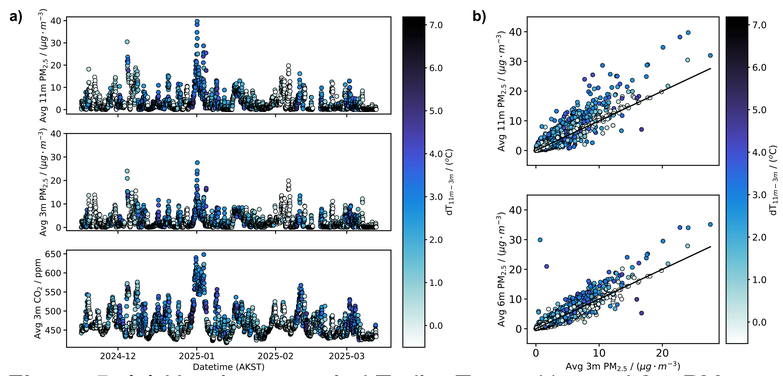


Figure 5: (a) Hourly resampled Trailer Tower 11m and 3m $PM_{2.5}$ and 3m CO_2 from 11/16/24 14:00 AKST to 3/12/25 14:00 AKST. **(b)** Hourly resampled Trailer Tower 11m $PM_{2.5}$ vs. 3m $PM_{2.5}$ (top) and 6m $PM_{2.5}$ vs. 3m $PM_{2.5}$ (bottom) from 11/16/24 14:00 AKST to 3/12/25 14:00 AKST. In both (a) and (b), all points are colored by the Trailer Tower's 11m – 3m temperature difference.

Conclusion

The airport region is the least-polluted site and possesses the largest inversion strengths, suggesting it has the fewest emission sources among the four sites. Hurst Road is the most-polluted site and possesses the second-largest inversion strengths. Ncore and A Street exhibit similar distributions of pollution and inversion strengths. Despite inversion strengths differing across sites in magnitude and shape, inverted periods start and end at similar times. At the airport region, ambient $PM_{2.5}$ concentrations are larger at 11m and 3m during inverted periods, possibly due to $PM_{2.5}$ deposition on snow and trees.

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References

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