Overview

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Background

• Maricopa County experiences challenges in meeting the national ambient air quality standards (NAAQS) for ozone.

• Maricopa County Air Quality Department (MCAQD) engages in collaborations with other government and academic partners to gain understanding of air quality issues that affect the region.
Purpose

In July 2021, MCAQD entered a partnership with Arizona State University (ASU) to better understand how NO$_2$ contributes to ozone formation in Maricopa County.

- Clarity Node-S low-cost sensors (LCS) study
Initial Calibration

- Prior to ozone season
- 12 LCS collocated for calibration with federal reference method (FRM) NO$_2$ and federal equivalent method (FEM) ozone monitors
- Miech et al, 2021
Periodic Calibration Checks

During ozone season (May – September)
  - LCS periodic calibration rotation: 12 sites
  - 2 weeks at site with FRM NO$_2$ monitor (red)
  - 6 weeks at site without FRM NO$_2$ monitor (green)
LCS Calibration

1. Raw Data
   - Period 1
     - Clarity Calibration
       - Sensor RH and Temp
       - 07:00-19:00
         - FRM Ozone Correction P1
           - Temp and RH re-correction
           - Negative Value Correction
           - FRM Ozone Correction P2
             - If Buckeye collocated additional high NOx correction
   - Period 2
     - Clarity Calibration
       - 20:00-06:00
         - FRM Ozone Correction P1
           - Temp and RH re-correction
           - Negative Value Correction
           - FRM Ozone Correction P2
             - If Buckeye collocated additional high NOx correction
   - Period 3
     - Training Dataset
     - Evaluation Dataset
Initial vs. Period Specific Calibration

![Box plot comparing Initial and Period Specific Calibration](image-url)
ASU Period Specific Calibration

Mesa

ASU NO$_2$ (ppb)

Sensor 11  Sensor 8  Sensor 2  Sensor 5

Analysis

- Using the period specific calibrated LCS data
  - Compared the log (NO$_2$/ozone) to better understand impact of NO$_2$ on ozone formation.
- Three possible ratios consistent with different NO$_2$ and ozone relationships
  1) NO$_2$ dominant
  2) Ozone dominant
  3) Equivalent NO$_2$ to ozone proportions
NO₂ Dominant Sites

South Phoenix (SP)
West Phoenix (WP)
Central Phoenix (CP)
Ozone Dominant Sites

Cave Creek (CC)
Dysart (D)
Mesa (M)
Pinnacle Peak (PP)
South Scottsdale (SS)
NO₂ / Ozone Equivalent Sites

Blue Point (BP)
North Phoenix (NP)
West Chandler (WC)
Buckeye (B)
Results Summary

- Three urban cores sites NO$_2$ dominated
  - SP, WP, and CP
- Peripheral monitoring sites outside urban core ozone dominated
  - CC, D, M, PP, and SS
- Upwind or more rural sites tend toward equivalent ratios of NO$_2$ to ozone
  - BP, NP, and B
Wildfire Smoke

- June 15, 2022
  - Transported wildfire smoke present
  - Morning NO$_2$ concentrations within usual ranges
    - All sites except Dysart and Cave Creek
  - Ozone exceedances at 13 sites
    - 0.108 ppm at North Phoenix
    - 0.107 ppm at Pinnacle Peak
    - Six other sites > 0.090 ppm
- ASU found that VOCs from smoke shifted the region to NO$_X$-limited conditions
Conclusion

- LCS can aid in better understanding the distribution of NO$_2$ concentrations over a large area.
- When a high degree of accuracy is required, LCS require a large amount of effort to periodically recalibrate the LCS from FRM NO$_2$ and FEM ozone measurements.
Questions
Thank you.

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