



Low Cost NO₂ Sensor Study

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Purpose

- Challenges meeting national ambient air quality standards (NAAQS) for ozone in Maricopa County
- Maricopa County Air Quality Department (MCAQD) partnered with Arizona State University (ASU)
 - Clarity Node-S low-cost sensors (LCS) study
- Goal: better understand how NO_2 contributes to ozone formation in Maricopa County

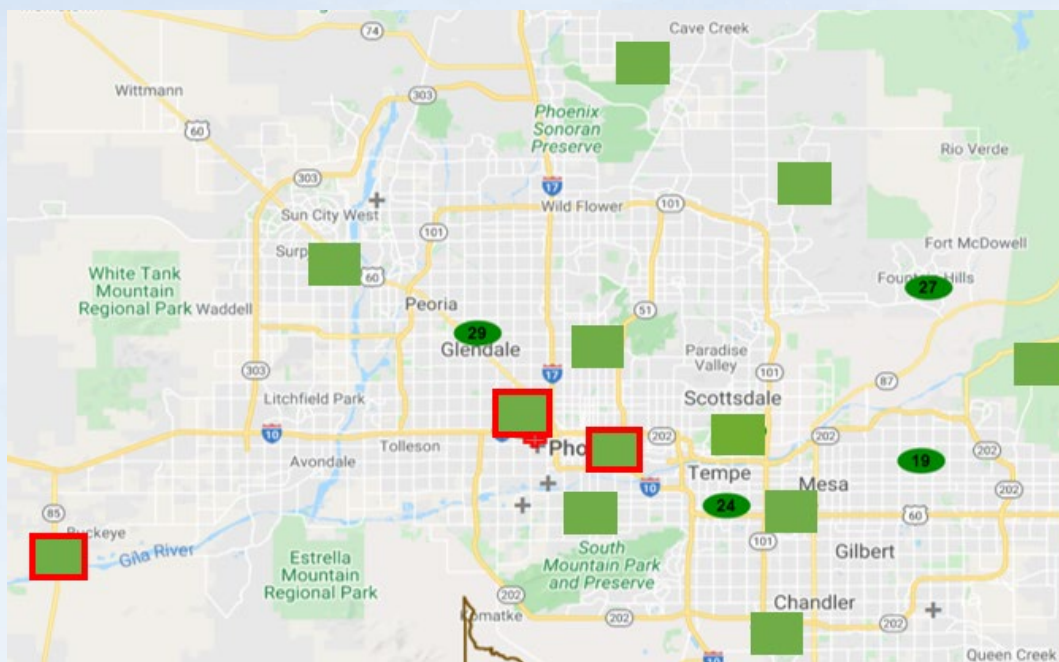
Initial Calibration

- Prior to ozone season
- 12 LCS collocated for calibration with federal reference method (FRM) NO₂ and federal equivalent method (FEM) ozone monitors
- Miech *et al*, 2021

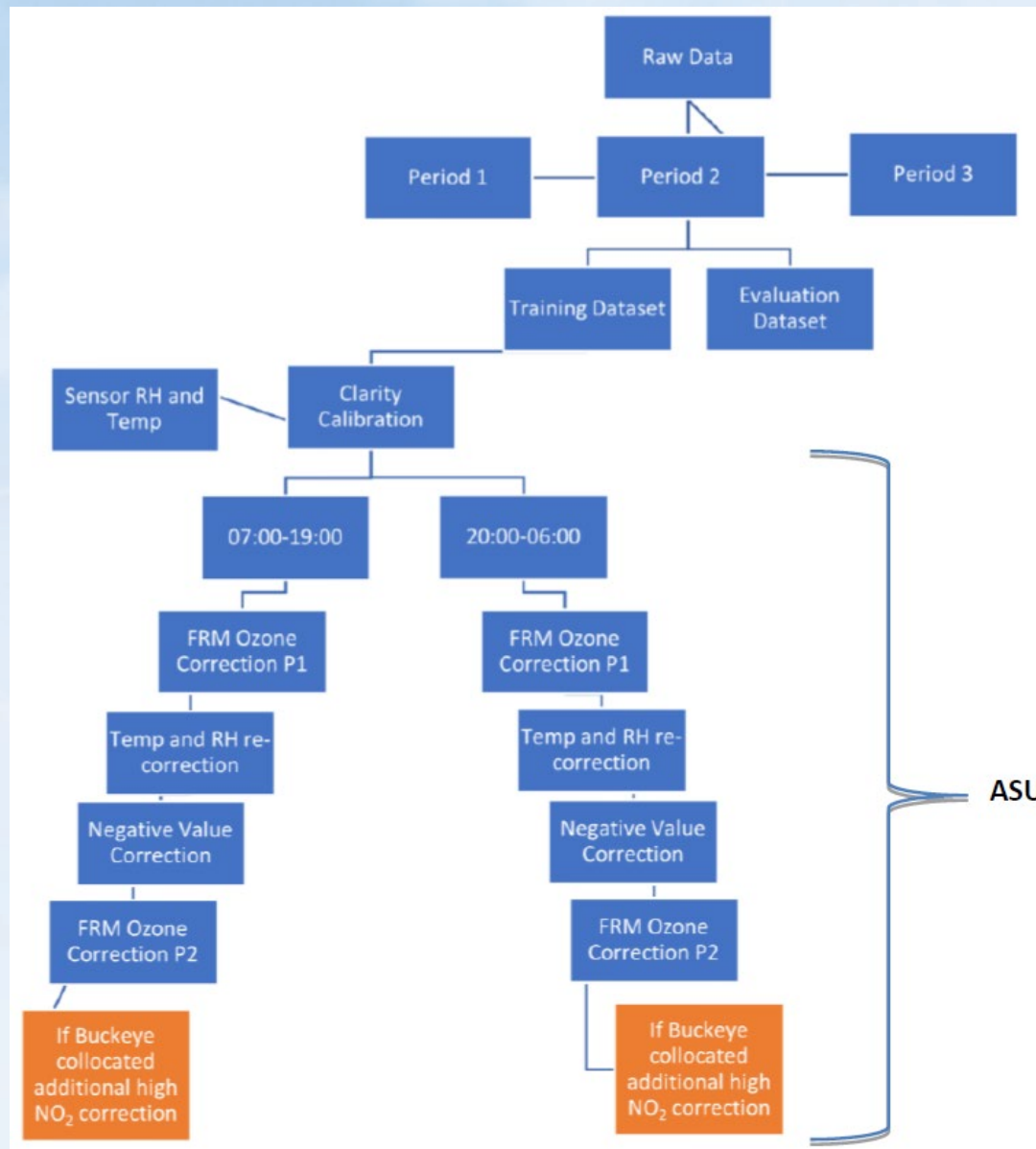


Periodic Calibration Checks

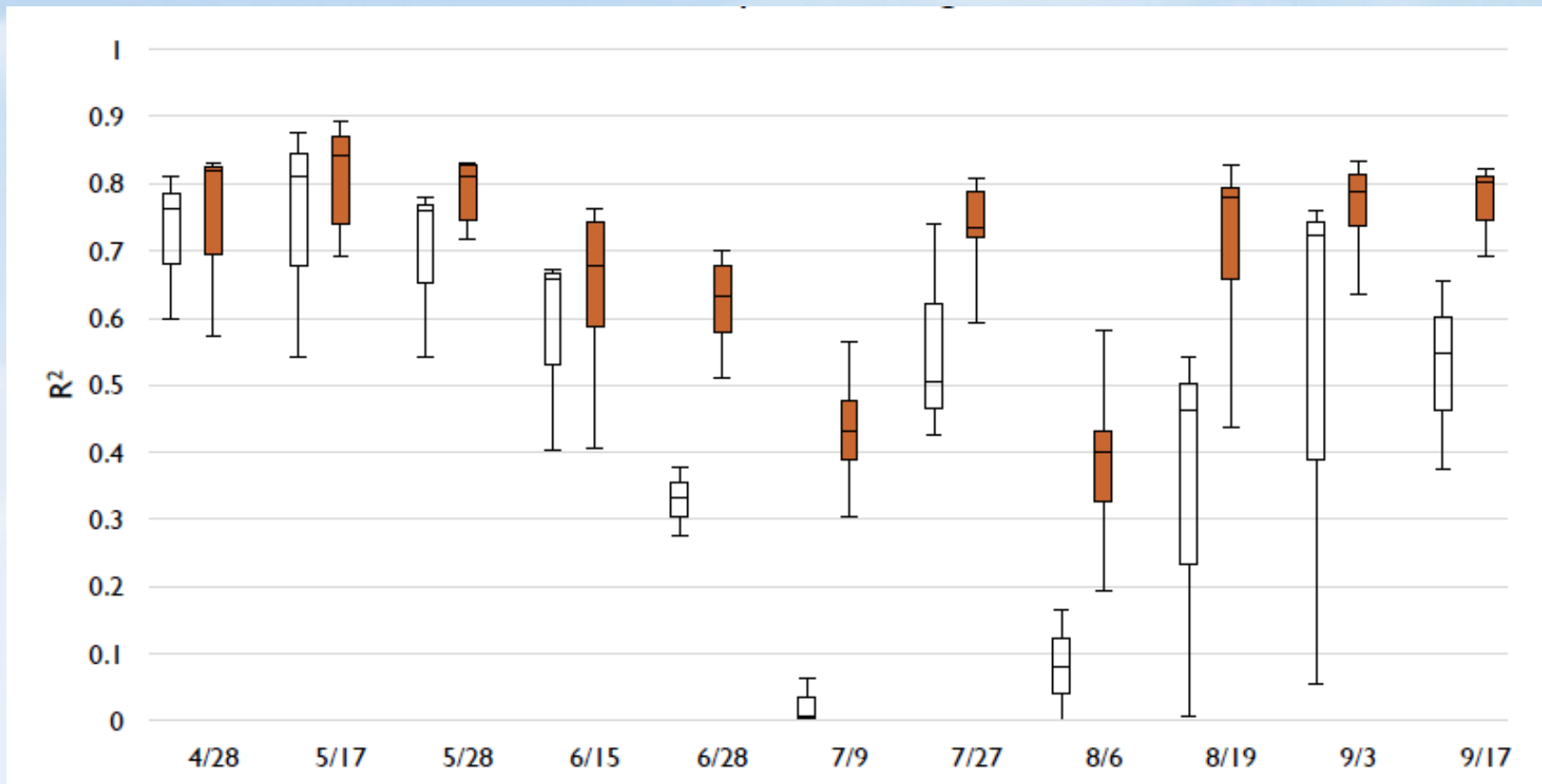
- During ozone season (May – September)
 - LCS periodic calibration rotation: 12 sites
 - 2 weeks at site with FRM NO₂ monitor (red)
 - 6 weeks at site without FRM NO₂ monitor (green)



LCS Calibration



Initial vs. Period Specific Calibration



Initial Calibration



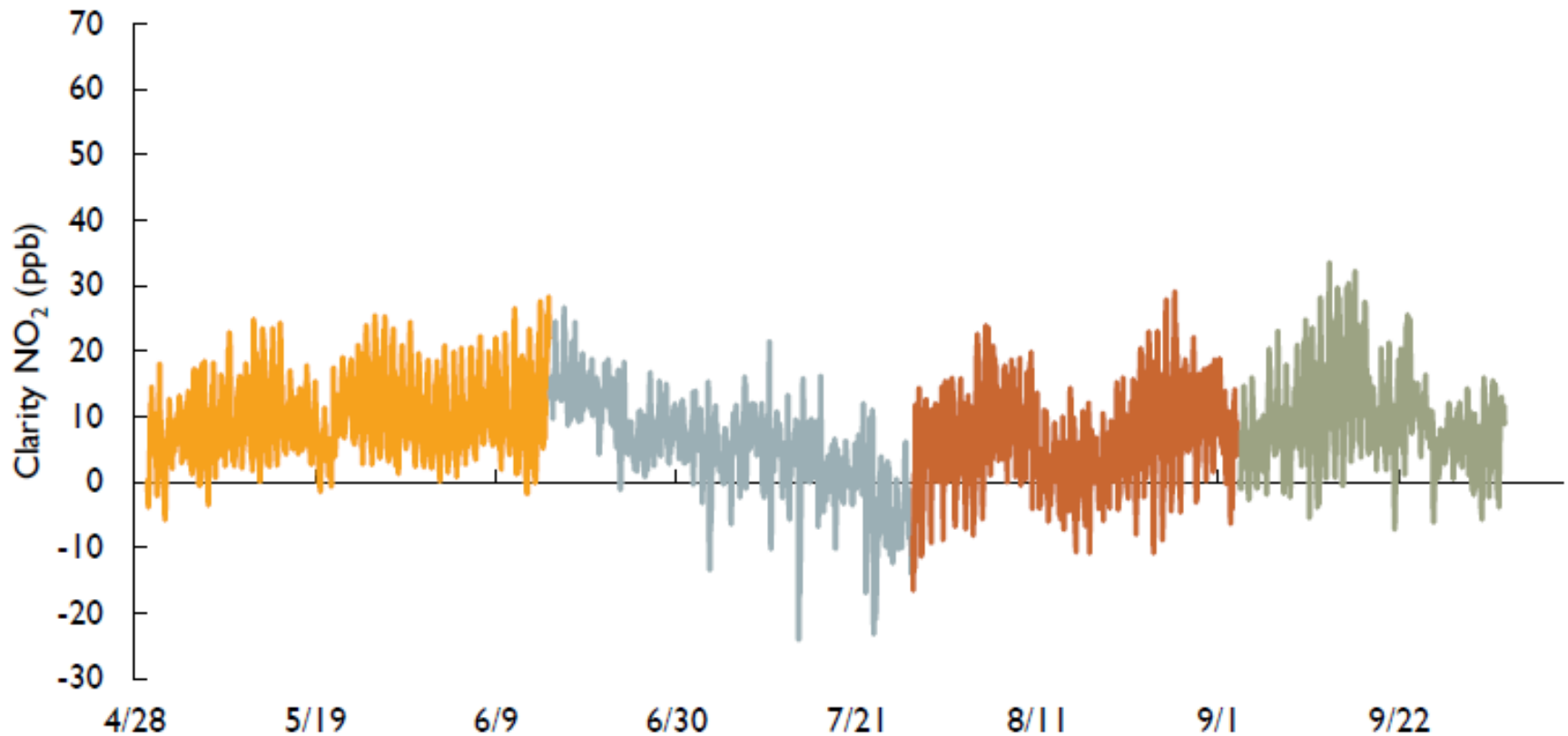
Period Specific Calibration

Original Clarity Calibration



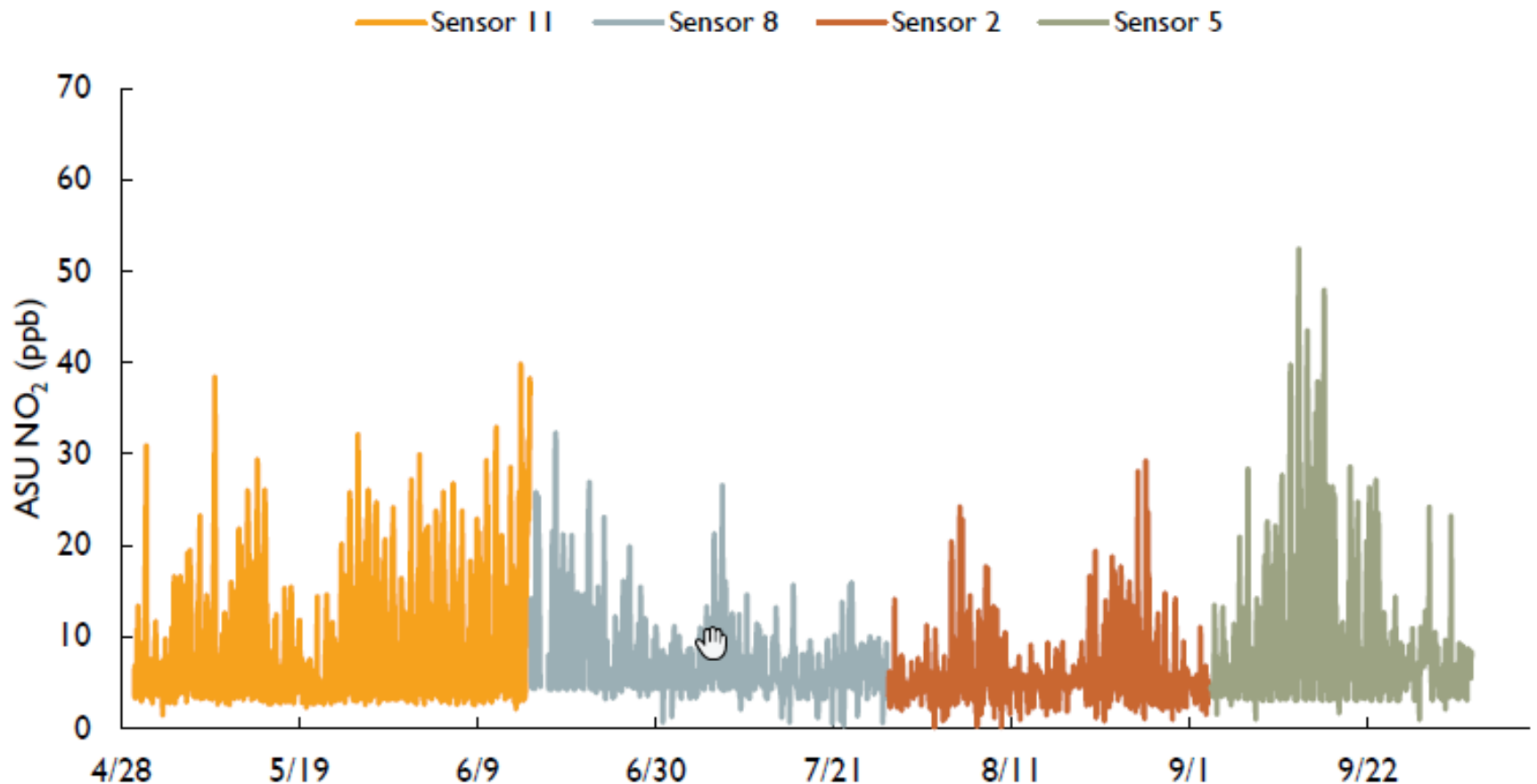
Mesa

Sensor 11 Sensor 8 Sensor 2 Sensor 5



ASU Period Specific Calibration

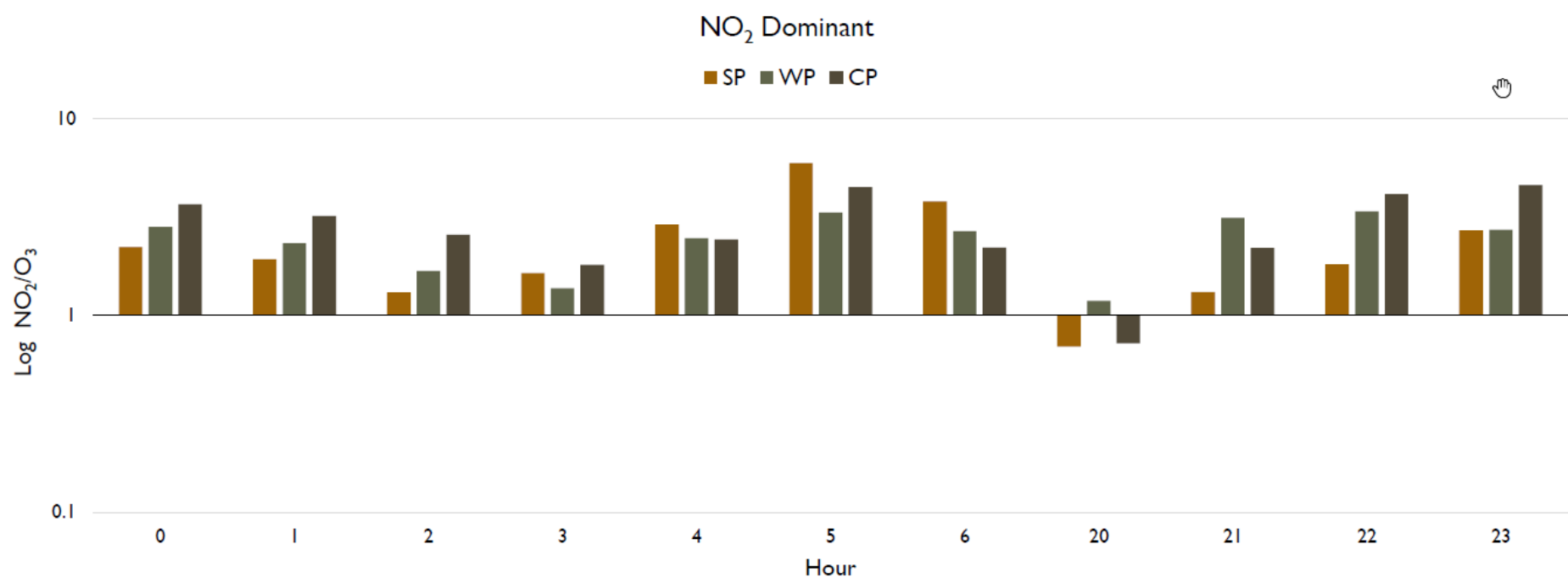
Mesa



Analysis

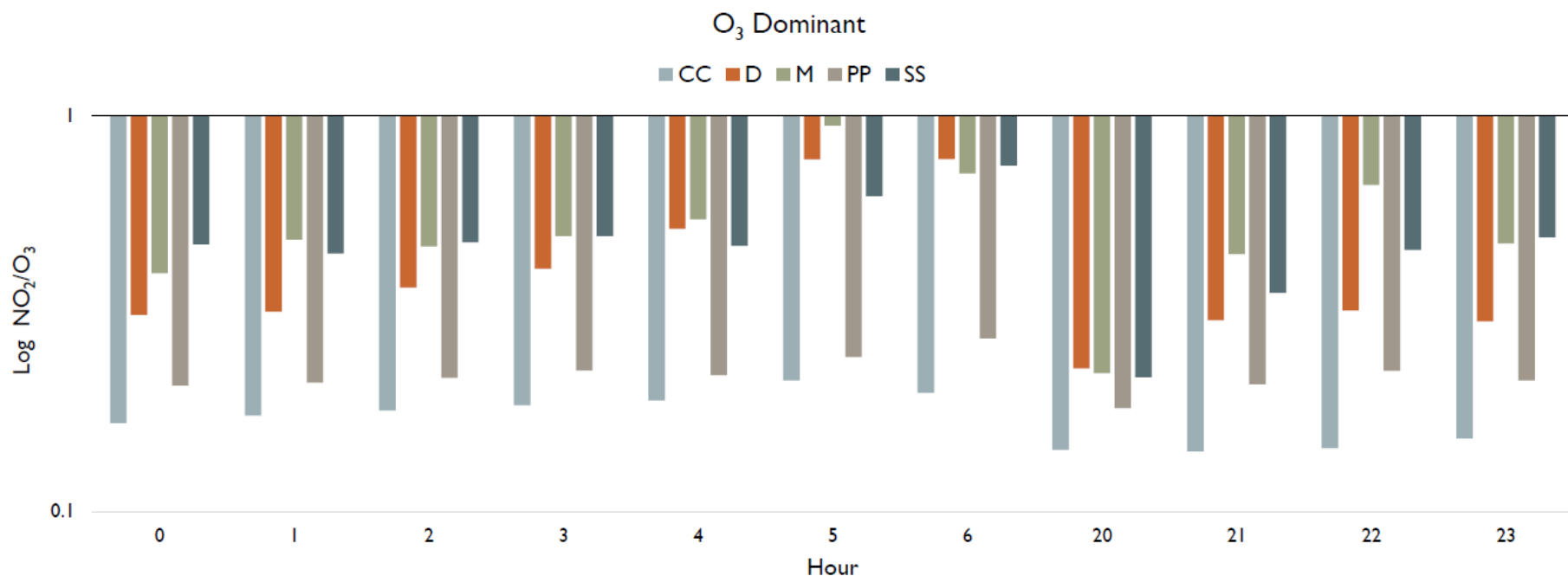
- Using the period specific calibrated LCS data
 - Compared the log (NO_2 /ozone) to better understand impact of NO_2 on ozone formation.
- Three possible ratios consistent with different NO_2 and ozone relationships
 - 1) NO_2 dominant
 - 2) Ozone dominant
 - 3) Equivalent NO_2 to ozone proportions

NO₂ Dominant Sites



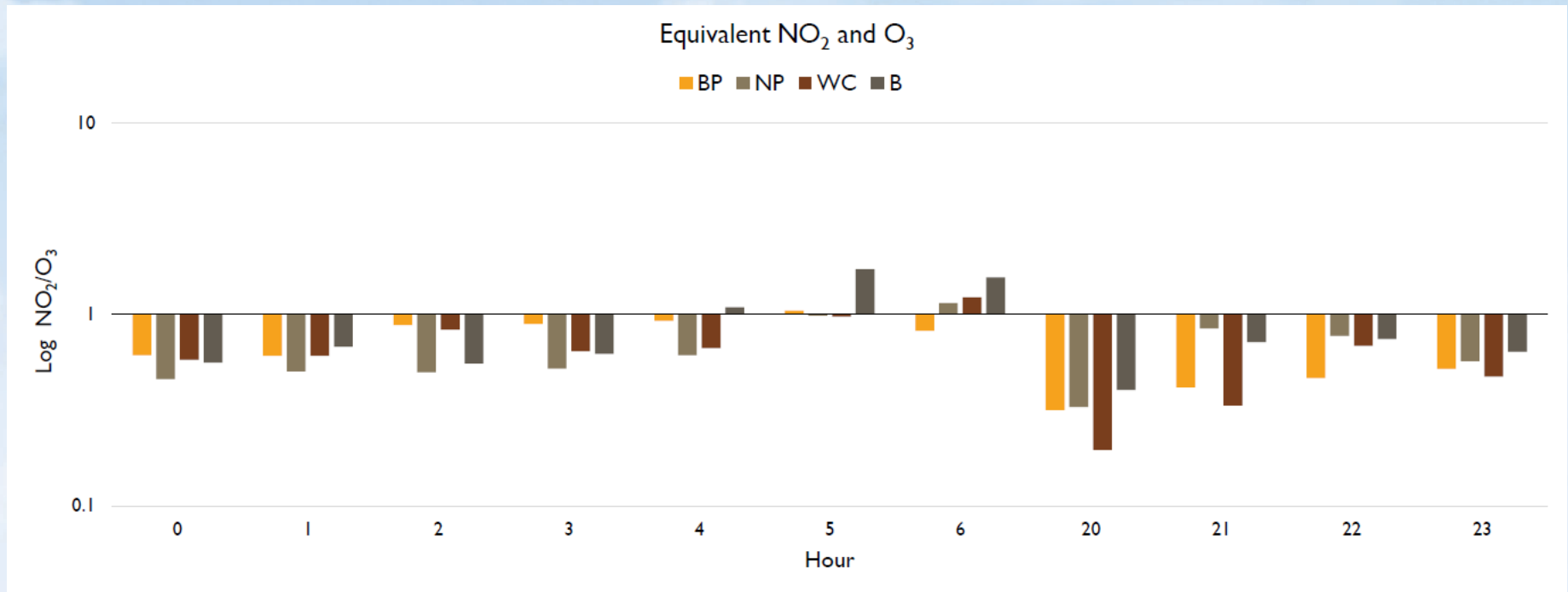
South Phoenix (SP)
West Phoenix (WP)
Central Phoenix (CP)

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 NO₂ 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 NO₂ to ozone
 - BP, NP, and B

Wildfire Smoke

- June 15, 2022
 - Transported wildfire smoke present
 - Morning NO₂ 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 NO₂ 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 NO₂ and FEM ozone measurements.

Questions



Thank you.

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