Speciated VOC Sampling to Understand VOCs and Sources Contributing to Ozone Formation in Maricopa County

Joshua Uebelherr, Senior Air Quality Planner
August 25, 2022

Overview

- Background
- Purpose
- Methods
- Summary sampling results
- Receptor modeling
  - Purpose
  - EPA Chemical Mass Balance (CMB) model
  - Results

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Background

Large areas of Maricopa County are classified as moderate ozone nonattainment areas:

- 2008 National Ambient Air Quality Standards (NAAQS)
- 2015 NAAQS (pending)

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Purpose

Speciated volatile organic compounds (VOC) sampling was conducted in order to gain a better understanding of how VOC sources contribute to ozone formation in Maricopa County.

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Methods

- Collected 24-hour air samples
  - SUMMA canisters
  - 2,4 dinitrophenylhydrazine (DNPH) cartridges
- May 4 to September 25, 2021
  - Sampling every 6 days at each site
- Samples were analyzed by Eastern Research Group
  - 88 VOC species
  - Total non-methane hydrocarbons

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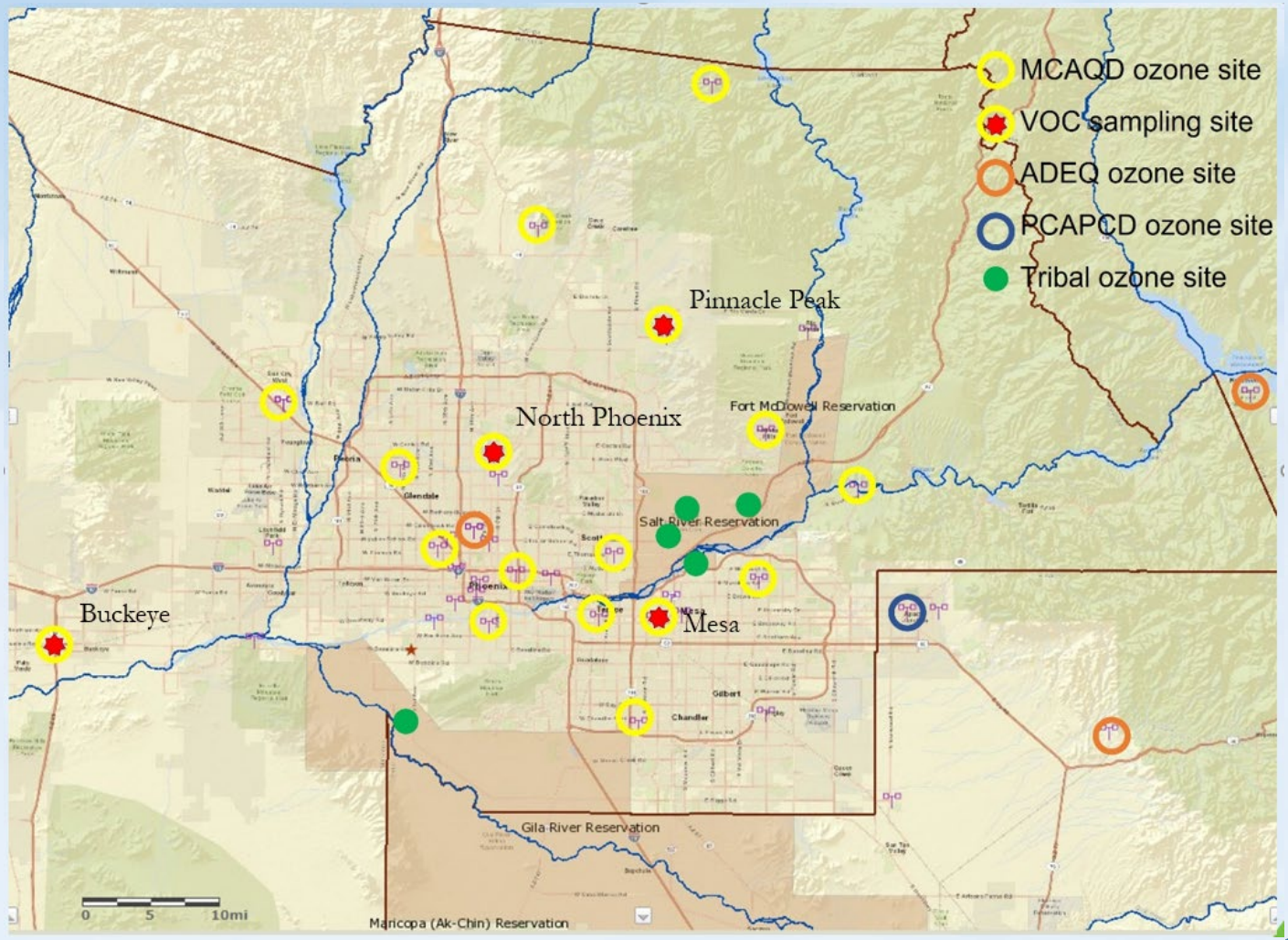
Sampling Locations



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Study Limitation

- Nearly 5,300 square mile nonattainment area
  - Four sample locations
  - Samples more heavily influenced by nearby sources
- Sampling dates may not be representative
- Analytical method identifies 88 out of thousands of VOC species in the atmosphere
- Not all species are equally reactive for ozone formation
- Limited availability of current source profiles for receptor modeling

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Sample Completeness

- Sampling scheduled using 1-in-6 days schedule for Photochemical Assessment Monitoring Stations (PAMS)
- 25 sample days from May 4 through September 25, 2021

Site	Number of Valid Samples
Buckeye	22
Mesa	25
North Phoenix	24
Pinnacle Peak	24

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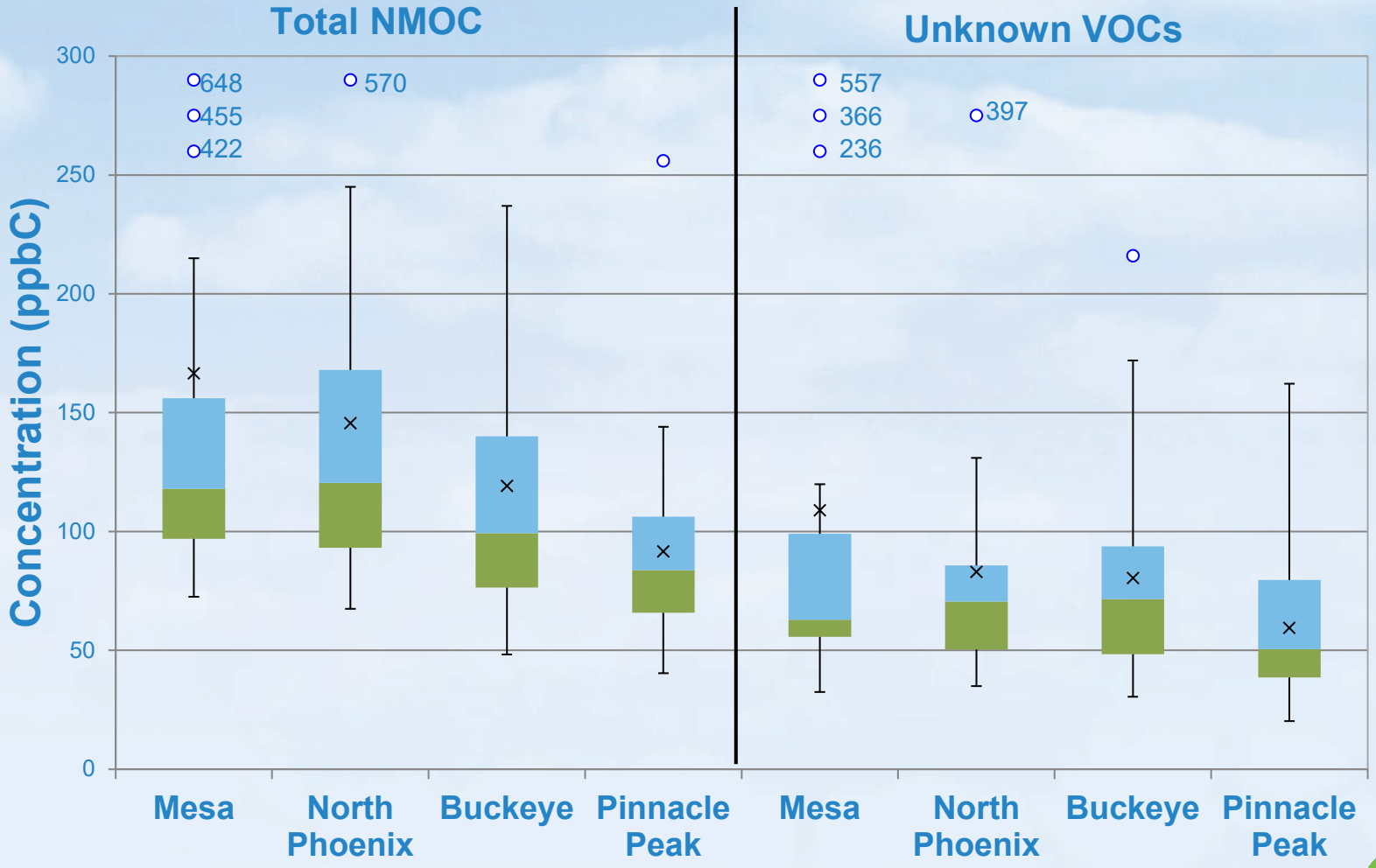
Sampling Results Summary



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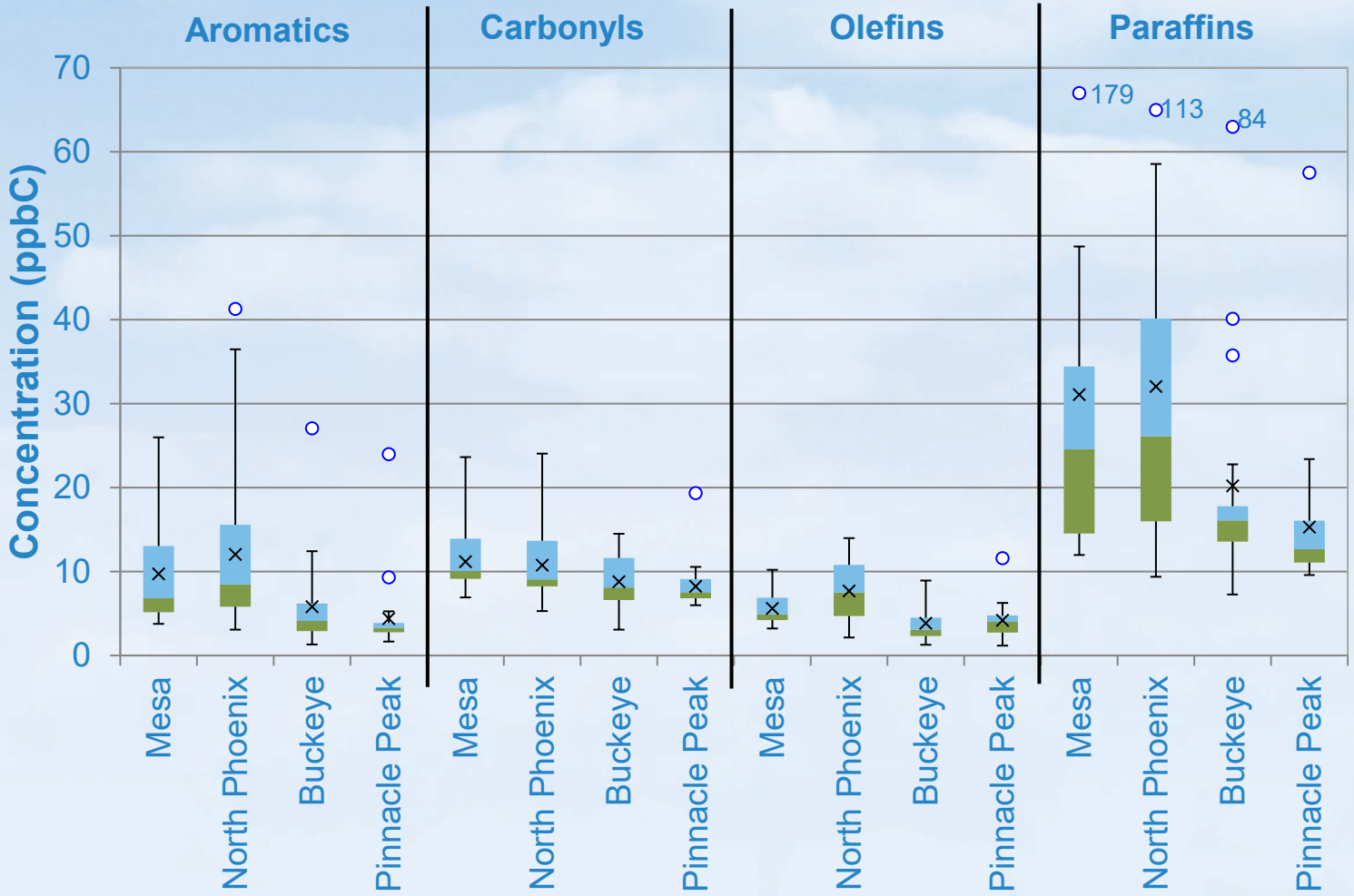
Sampling Results Summary



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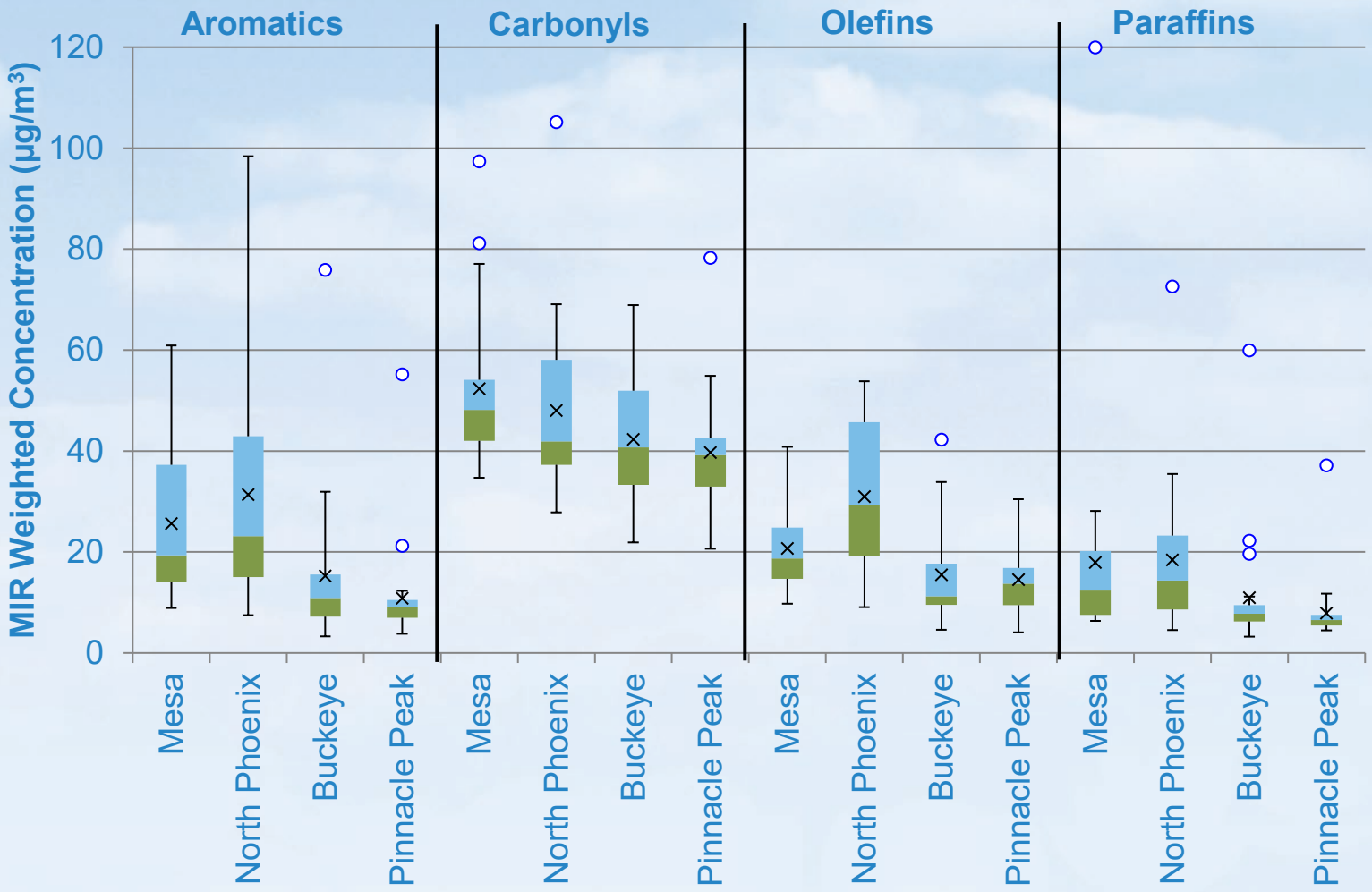
Relative Ozone Impact



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Receptor Modeling

- Receptor modeling uses multivariate statistical techniques with speciated monitoring data to identify sources of pollution
- EPA Chemical Mass Balance (CMB) model, version 8.2 compares monitoring data to emission source profiles
  - Takes unknown VOC into account
- Source profiles extracted from the EPA SPECIATE database, version 5.1

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Preparation of Data for CMB

- Screening of ambient data to determine reliable measurements for VOC species
  - Exclude species with all non-detects and high percentage measured below detection limits
- Extract multiple source profiles from SPECIATE database for source categories likely to affect ambient VOC concentrations
- Reformat ambient and source profile data to CMB requirements

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Modeling Approach

- CMB models each sample separately to compare concentrations against source profiles
- Days were classified and data averaged based on ozone concentrations and exceptional event status
  - Moderate days (17 days)
  - Exceedance days not flagged for wildfire smoke influence (2 days)
  - Wildfire smoke exceptional events (6 days)
- Outlier days excluded from some averages
  - Spikes in specific VOCs
  - Unknown VOC over 70% of TNMOC

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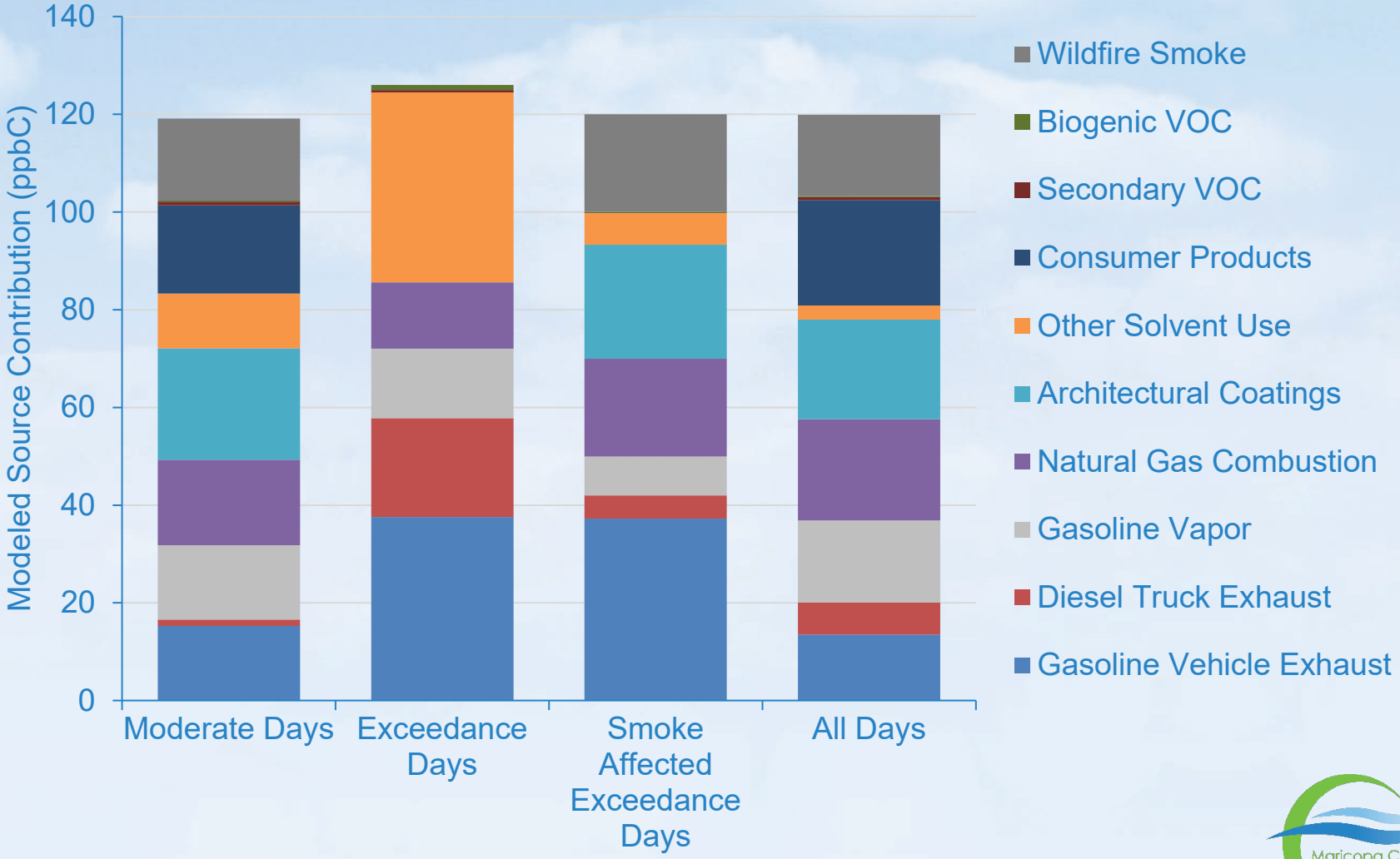
Mesa



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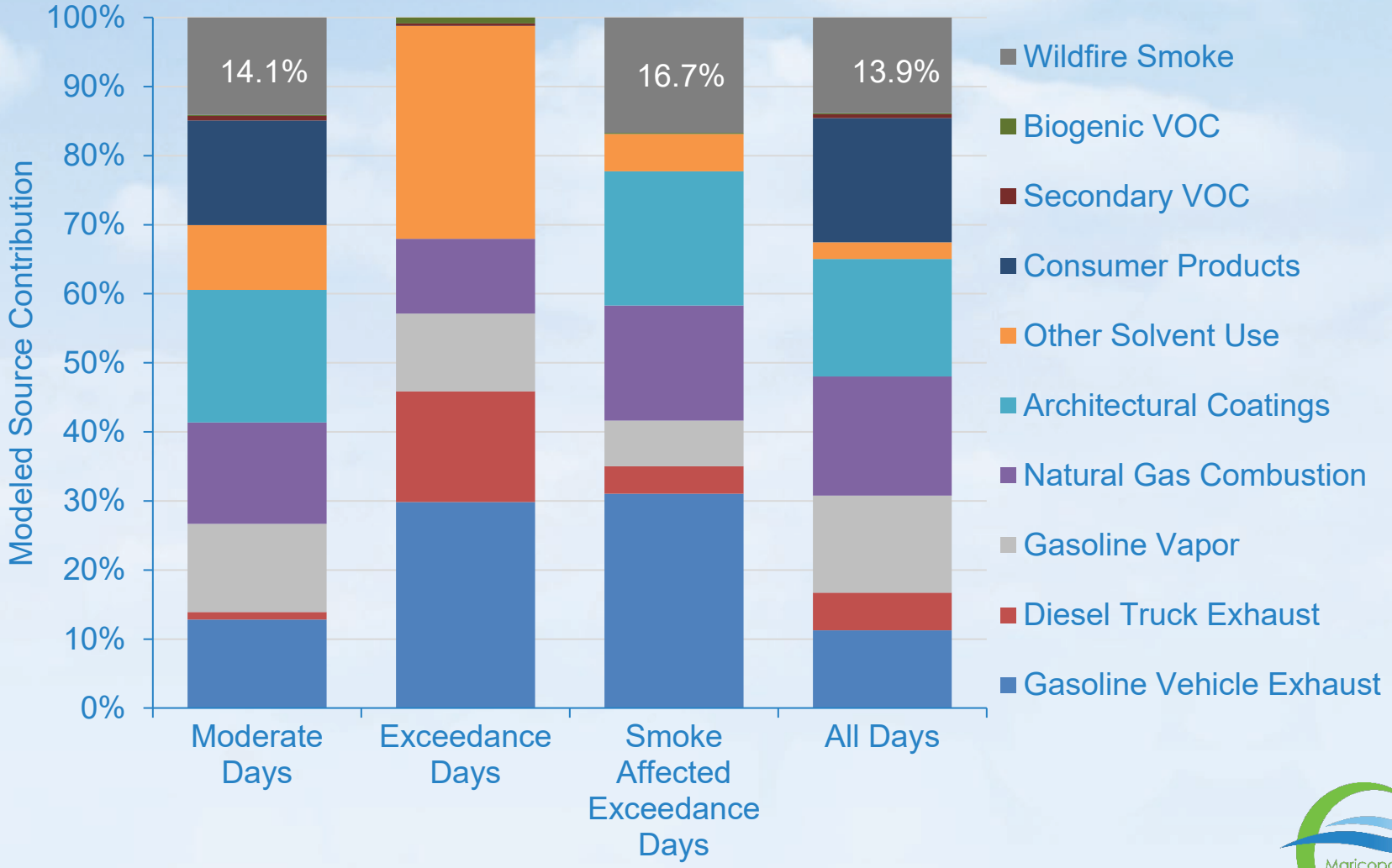
Mesa



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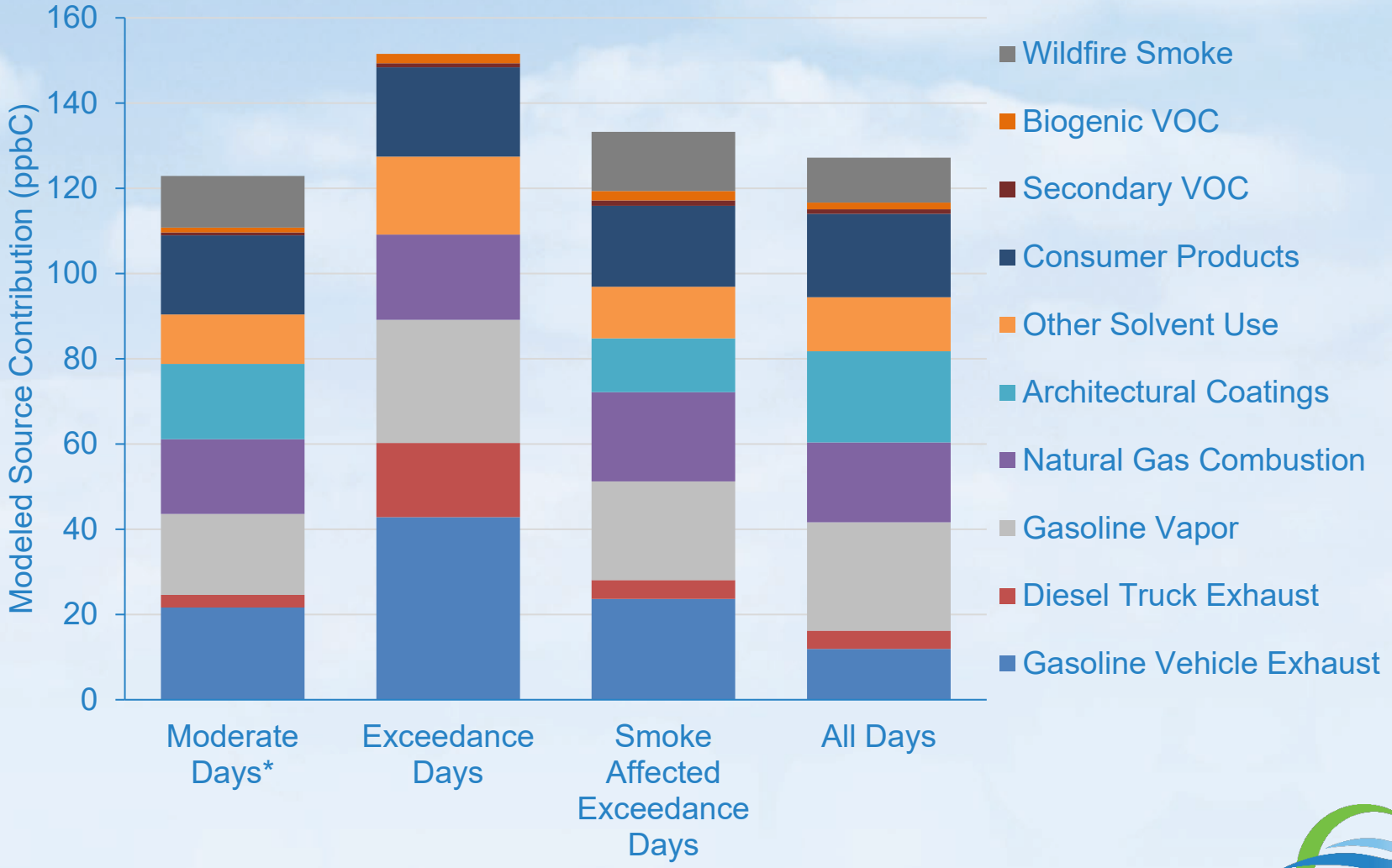
North Phoenix



* Excluding June 3 and August 8, 2021

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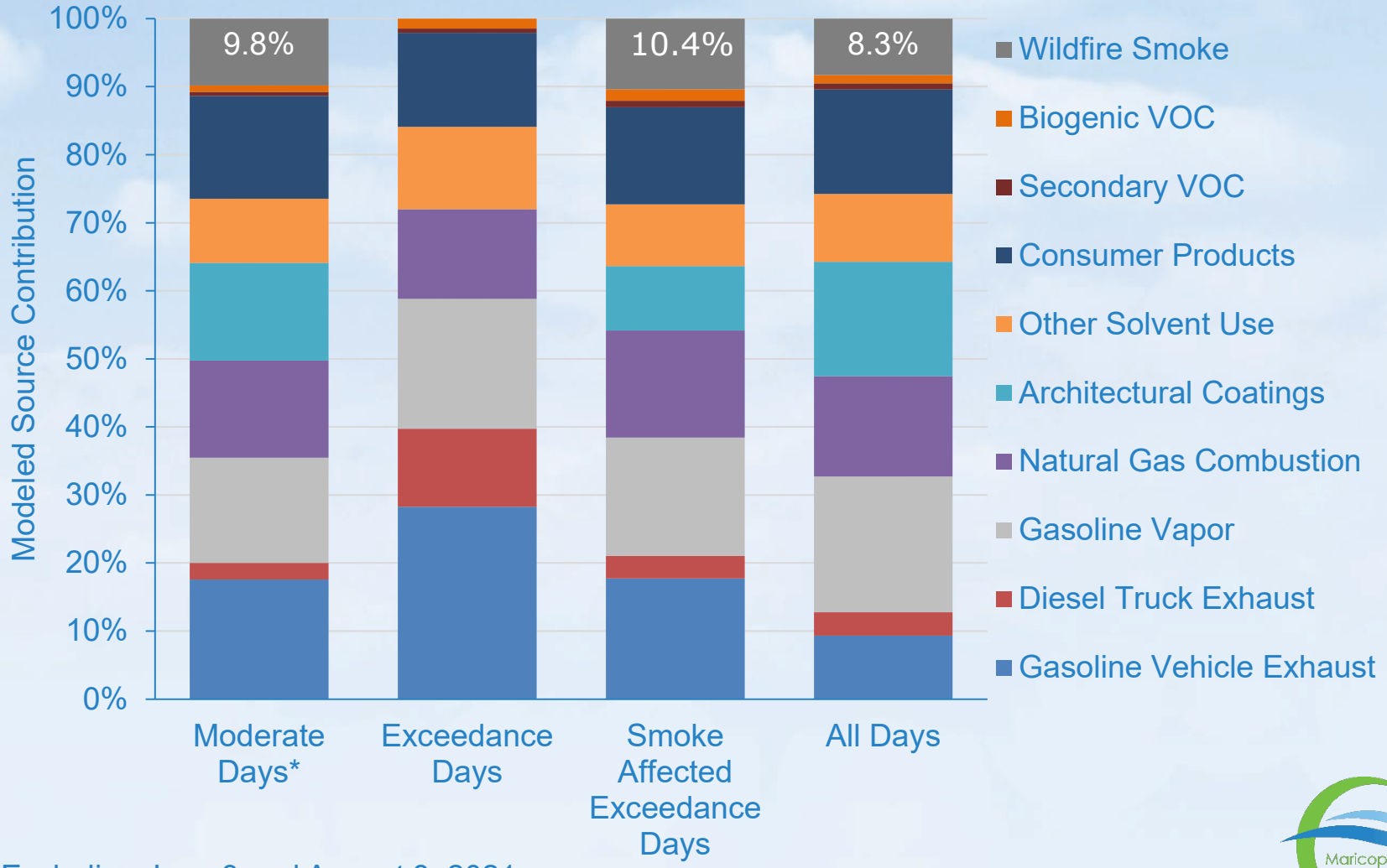
North Phoenix



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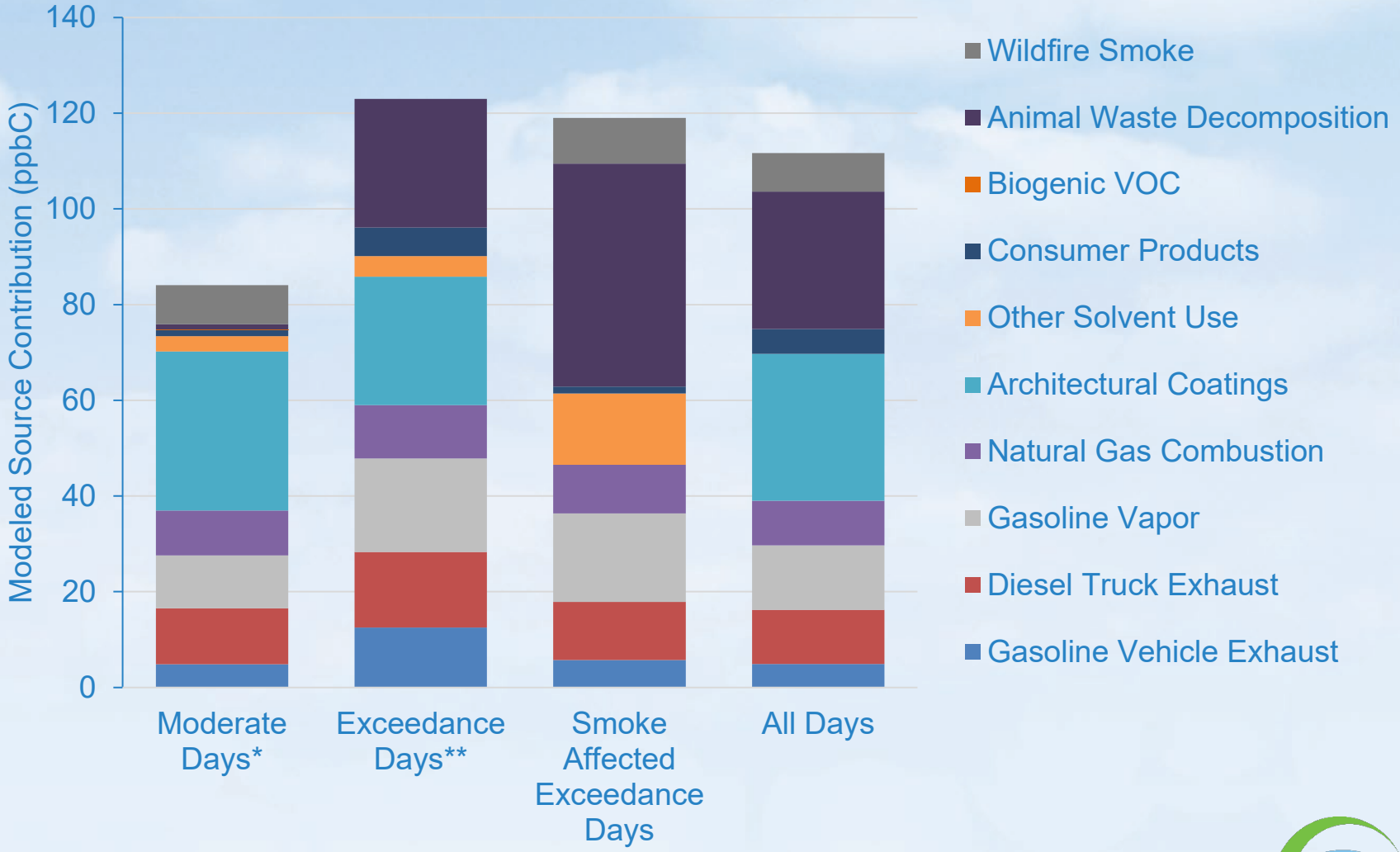
Buckeye



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** Excluding June 9, 2021

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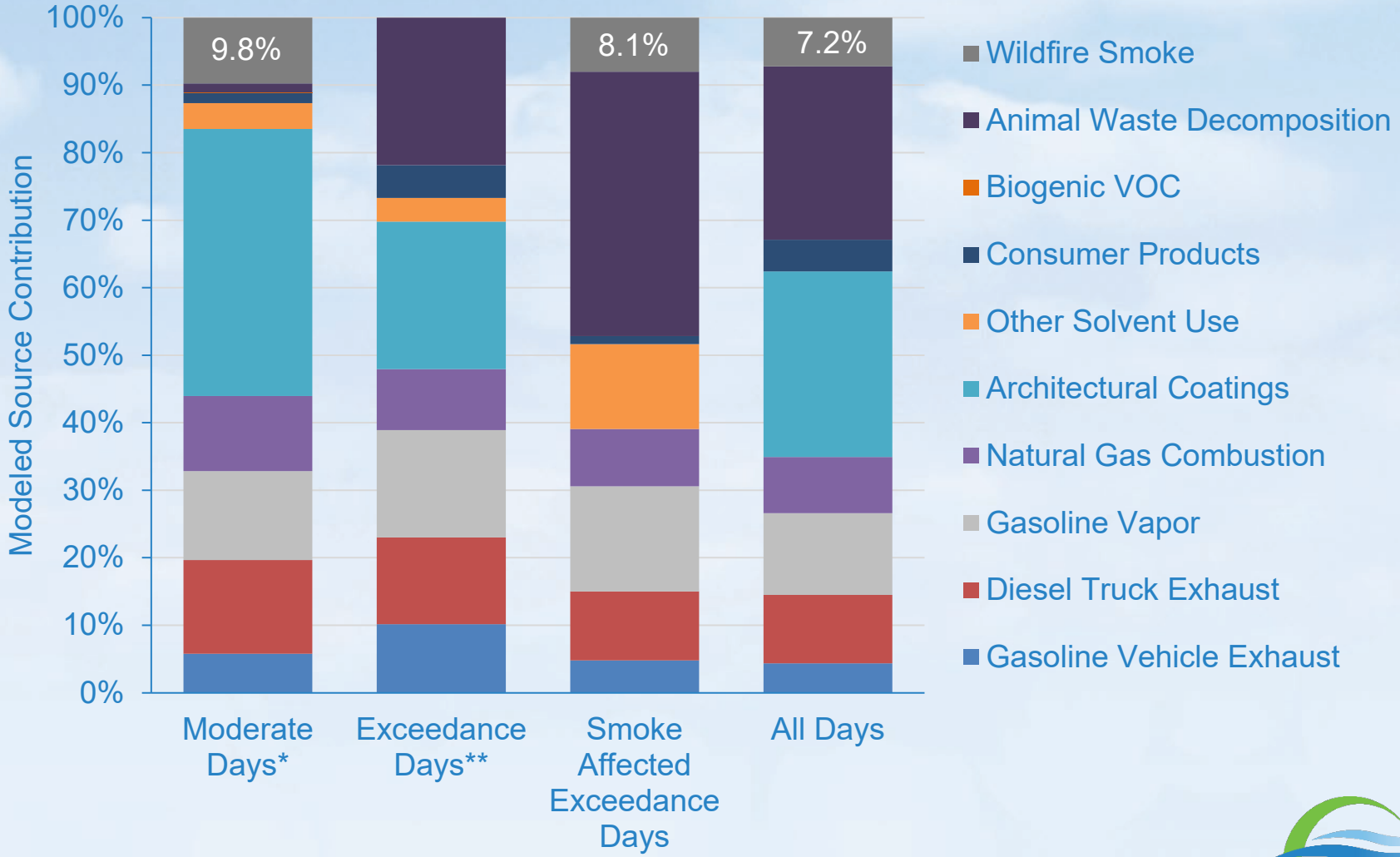
Buckeye



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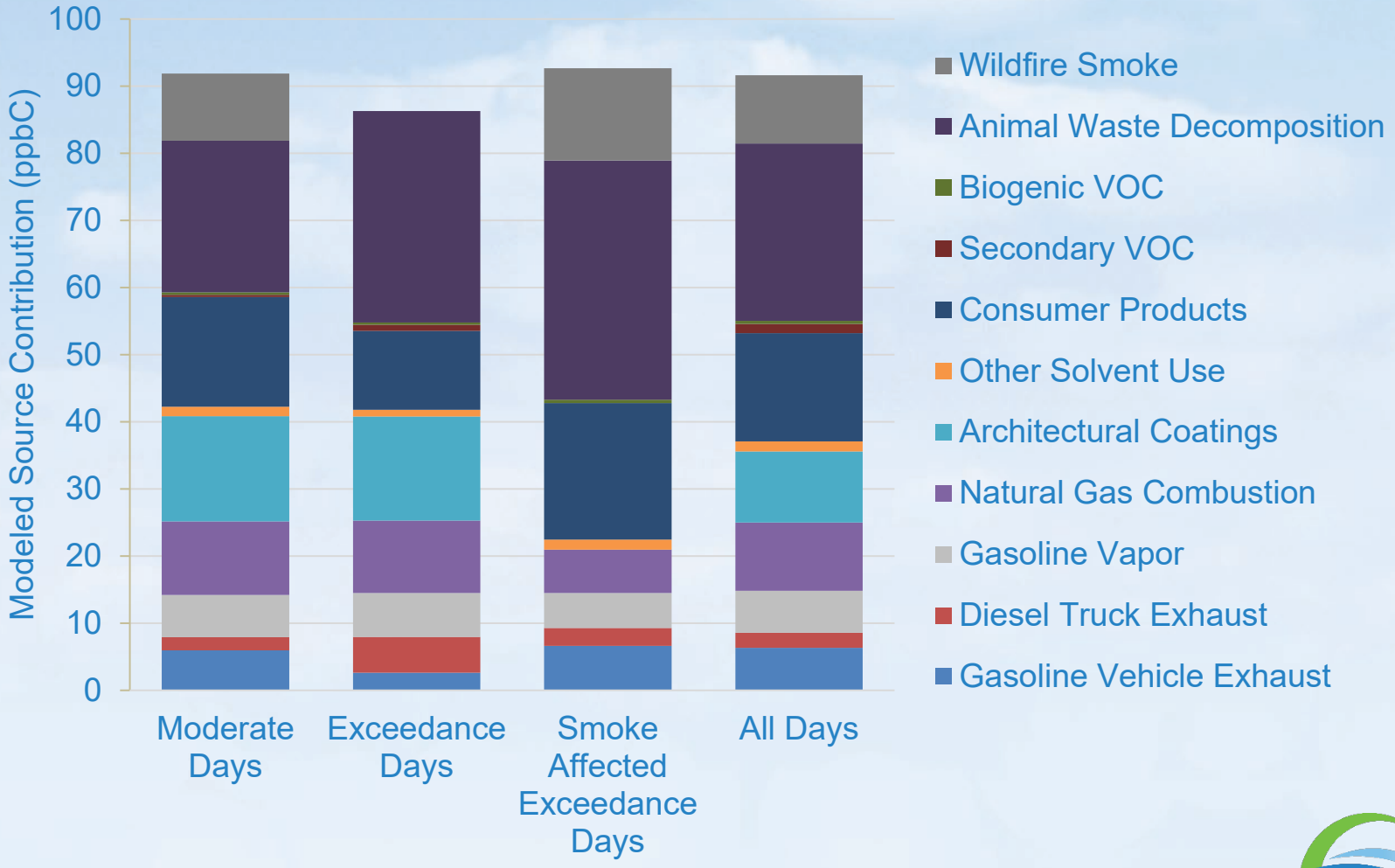
Pinnacle Peak



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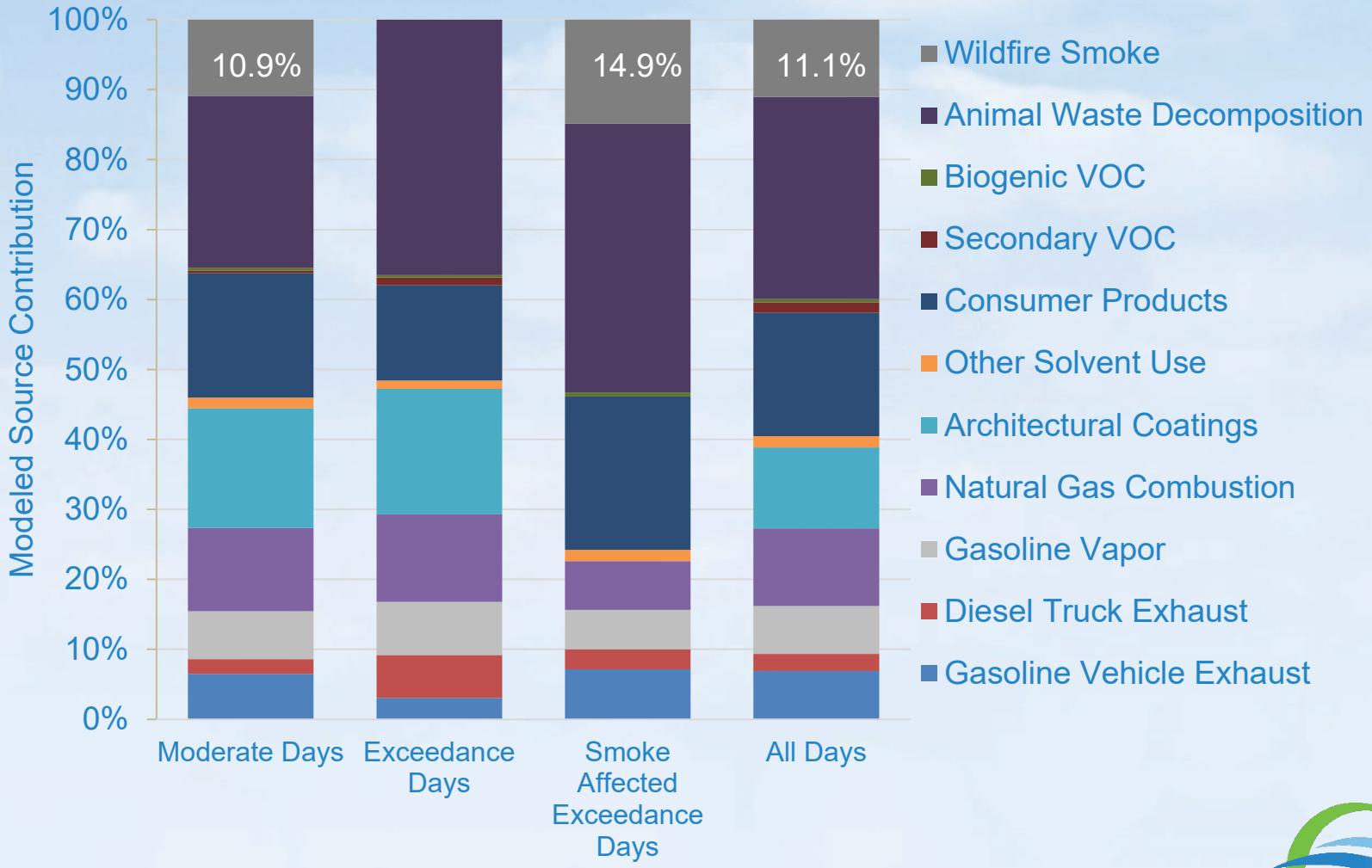

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Summary

Patterns that stand out include:

- Dominance of solvent related source categories on moderate days
- Mobile sources more dominant on exceedance days at the urban sites
- Wildfire smoke is significant for days after June 15, 2021

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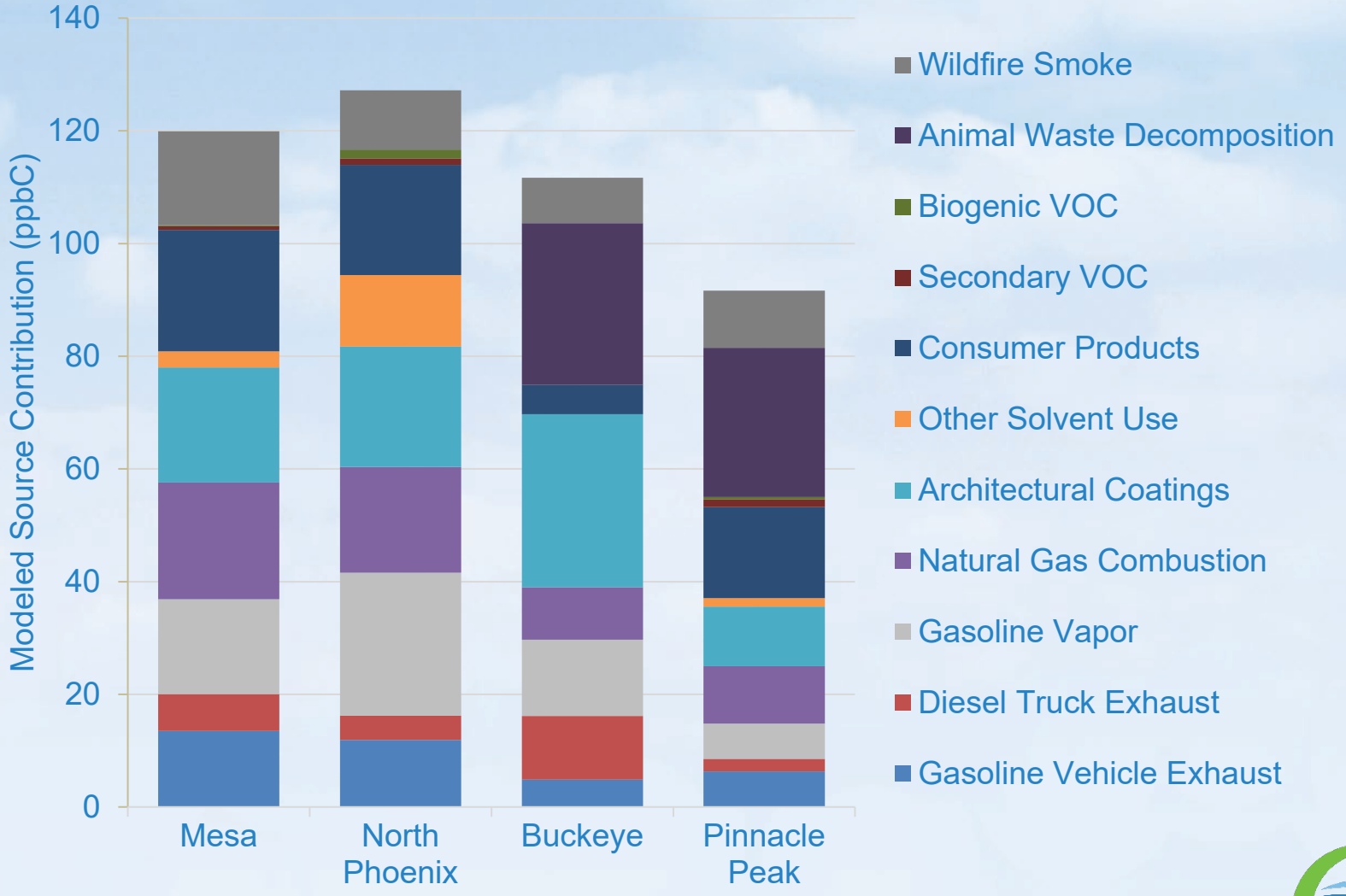
Average All Samples



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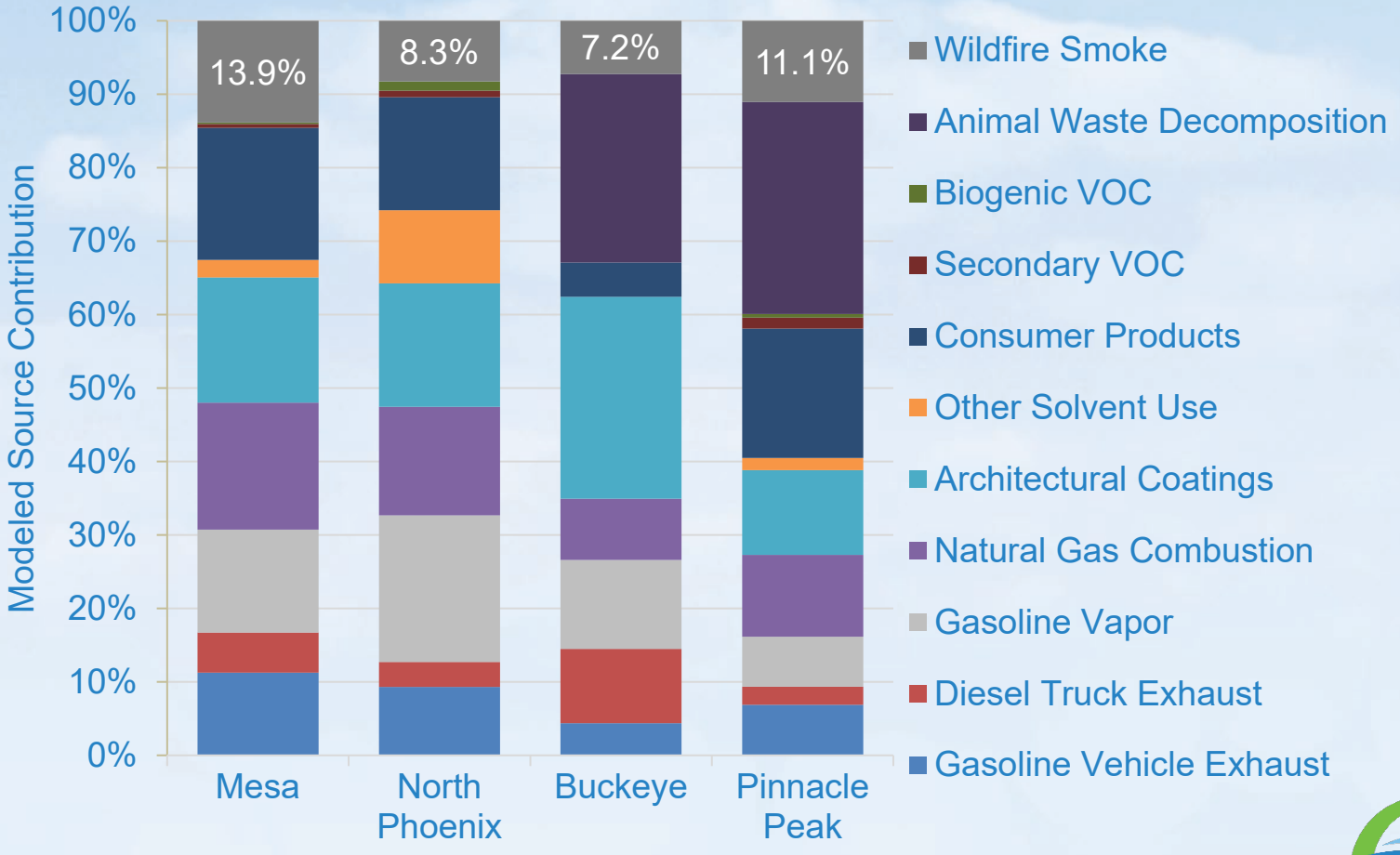

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Questions

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Thank you.

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