CALIFORNIA
AIR RESOURCES BOARD

Benefits of a HAMAQ Deployment in California

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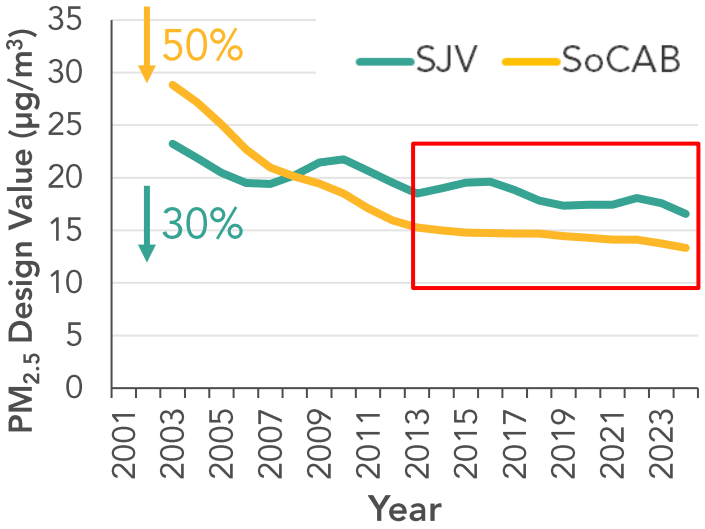
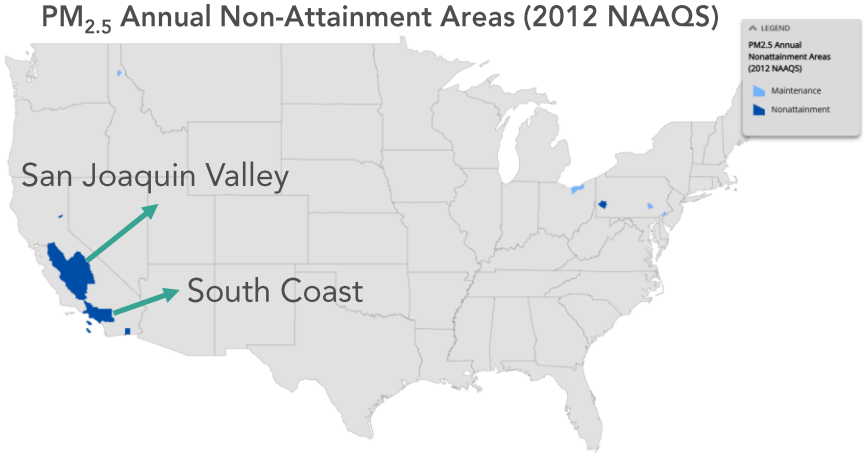
California Air Quality Challenges

- Science-based policies have led to major air quality improvements in CA
- However, the San Joaquin Valley (SJV) and the South Coast Air Basin (SoCAB) still have the highest average ozone and $PM_{2.5}$ levels in the U.S. and remain in serious nonattainment status, calling for additional research



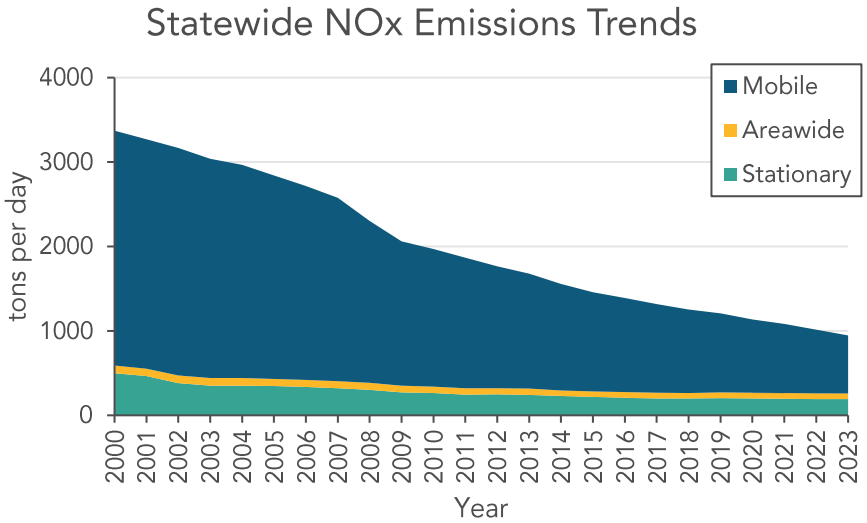


https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=8fbf9bde204944eeb422eb3ae9fde765

Why California AQ Challenges Persist?

- Diverse makeup of high-emitting sources: mobile sources, urban centers, industries, agricultural and dairy operations, natural sources, etc.
- Topography: In the SJV, shallow boundary layers trap air pollutants close to the surface
- California's climate: limited rainfall restricts pollutant removal via wet deposition, while hot, stagnant summers drive rapid ozone formation
- Emerging sources and non-uniform chemical regimes complicate effective mitigation

California Topographic Relief Map

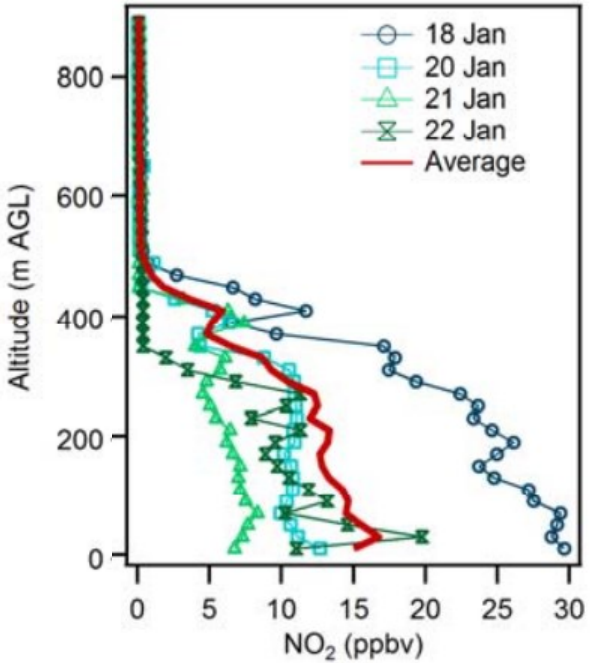


https://ww2.arb.ca.gov/applications/cepam2019v1-04-standard-emission-tool

Better Satellite-Surface Connection with HAMAQ

- Satellite products inform many of the CARB programs
- SJV's complex winter vertical profiles make satellite data interpretation challenging
- HAMAQ's detailed vertical profiles are essential to link SJV's column-integrated measurements from TEMPO and the forthcoming MAIA to ground-level pollutant concentrations, especially in the winter

Observed afternoon vertical profiles over Fresno during DISCOVER-AQ



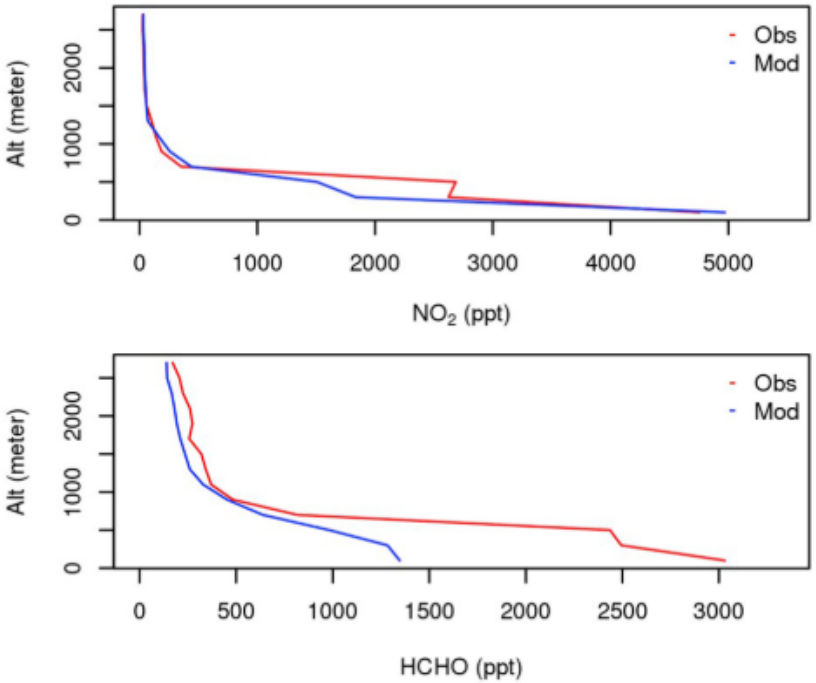
https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/14-307.pdf

SIP Modeling Improvement with HAMAQ

- Air quality improvements narrow the margin for error in SIP modeling, making vertical pollutant profiles observations critical for accurate modeling

- HAMAQ's high-resolution vertical profile measurements will potentially fill the observational gaps for improved model estimation

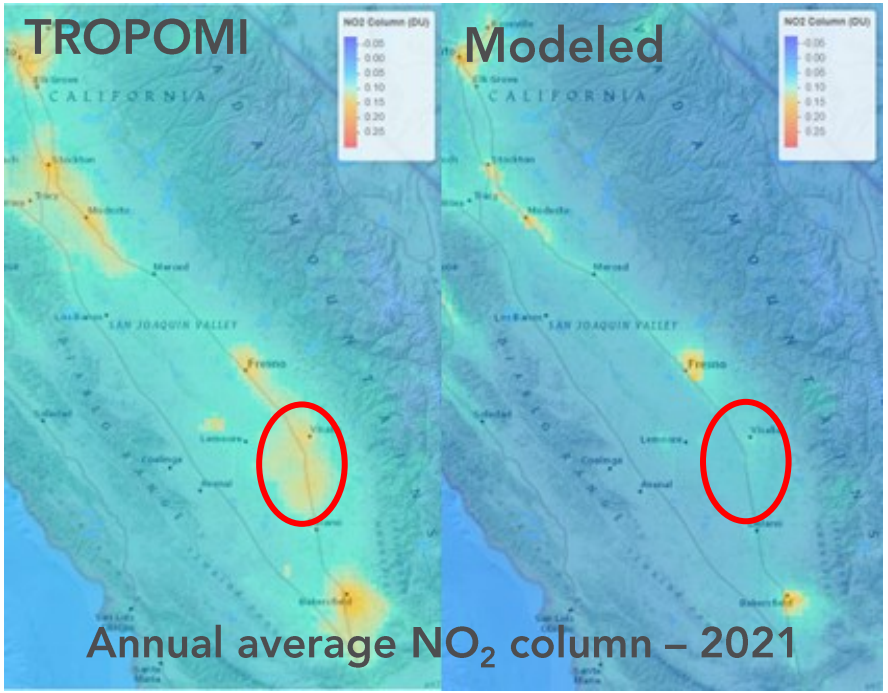
Observed and modeled vertical distributions over Fresno on Jan 20, 2013 (DISCOVER-AQ)



Chen, Jianjun, et al. *Atmospheric Environment: X* 5 (2020)

Emissions Inventory Improvements with HAMAQ

- Non-vehicular emission sources are becoming more important for the future attainment of air quality standards
- **Example:** Model evaluations against TROPOMI suggest missing or mischaracterized NOx sources in the SJV at certain times or years
  - While existing and planned efforts will shed light on these sources, none focus on winter data, a period with highest $PM_{2.5}$ concentrations
  - HAMAQ's winter data will potentially fill this gap
- Other underrepresented emission sources could also be better characterized by utilizing the HAMAQ data



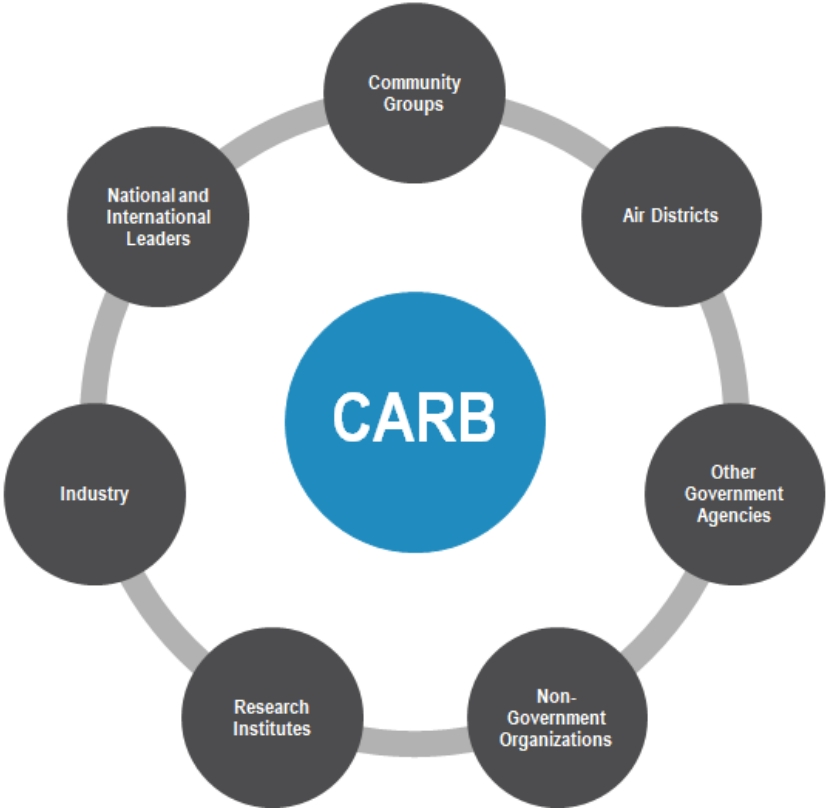
California's Measurement Capabilities to Support HAMAQ

- **Advanced ground-level monitoring:**
  - CHAMP (CARB High-resolution Advanced Monitoring Program) Network:
    - Speciated NR-$PM_{2.5}$, BC, speciated VOC, HCHO, NH_3, CH_4, CO
    - Operational in Fresno and Bakersfield – expanding to up to 8 sites in 2026
  - ASCENT Network:
    - Speciated $PM_{2.5}$
    - Three operational sites in Southern California

- **Mobile measurement platforms** with advanced instrumentation can provide valuable ground-level data

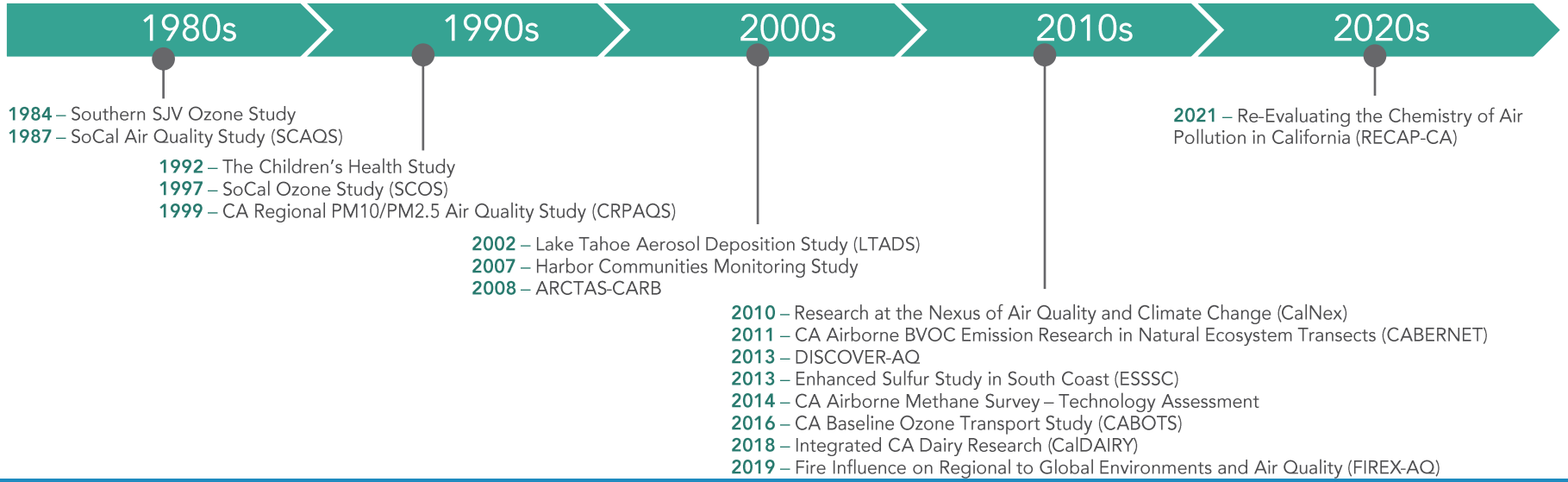
Leveraging CARB's Research Program and Collaborators

- CARB allocates $4–8M annually to external research funding
- Funds can potentially support additional HAMAQ measurements and analysis
- CARB can leverage its network of collaborators to maximize HAMAQ's scientific and policy impact



Building on a Legacy of Success

- Previous field campaigns have led to air quality improvement in California
- Major gaps remain as California still faces the nation's worst air pollution challenges
- CARB looks forward to building on the successful partnerships formed over the previous field campaigns and, together, making HAMAQ deployment in California a success



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