

Three-State Air Quality Study (3SAQS)



Three-State Data Warehouse (3SDW)

Air Pollutant Emissions Modeling and Analysis for the Three-State Air Quality Study

Z. Adelman, M. Omary, D. Yang

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University of North Carolina – Institute for the Environment

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ENVIRON International Corporation

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Western States Air Resources Council

Presented at the 21st International Emission Inventory Conference
April 14-16, 2015 – San Diego, CA

Western States Air Quality Study



Intermountain West Data Warehouse

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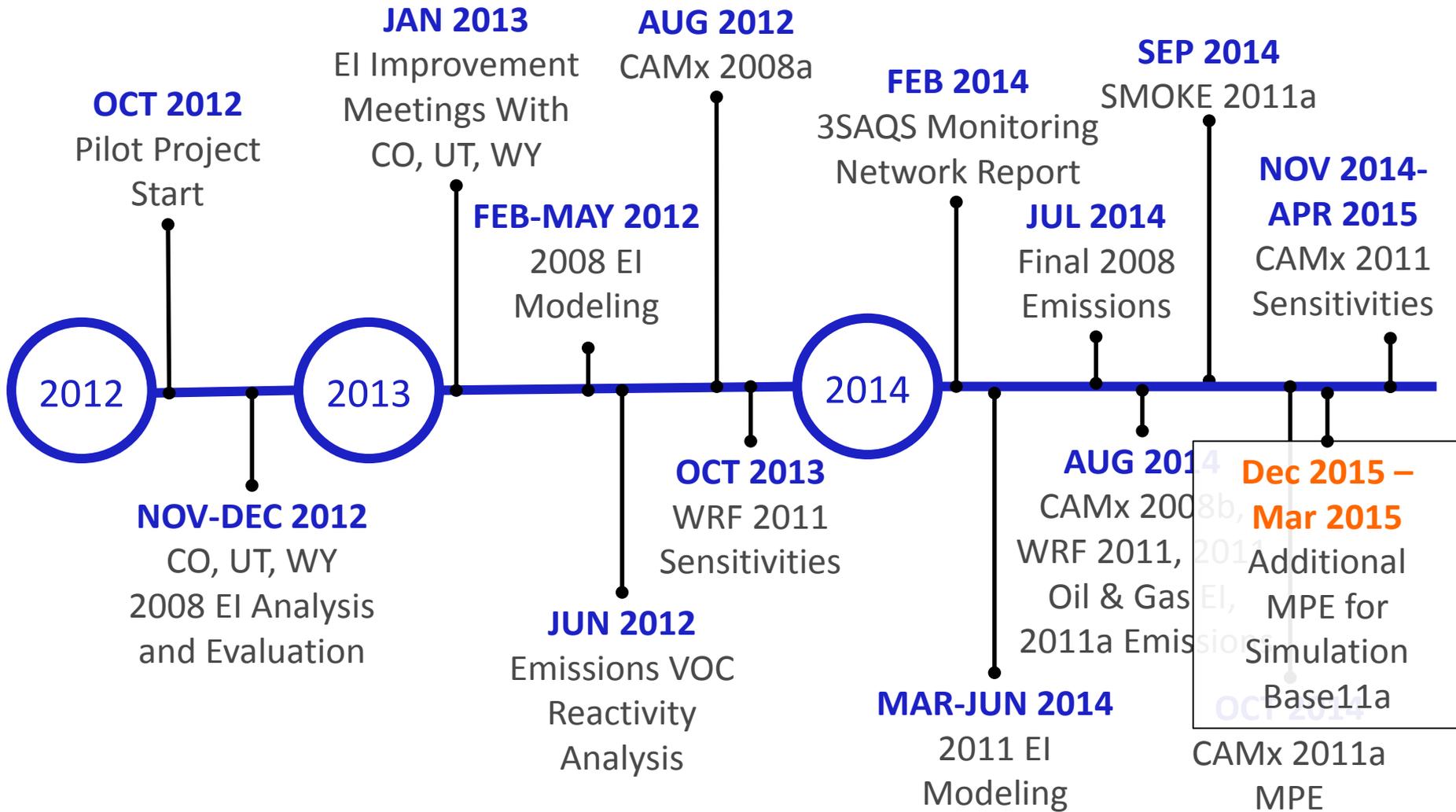
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Western States Air Quality Study

- Assess environmental impacts related to oil and gas development and production
- Develop and distribute standardized and transparent databases and modeling platforms for National Environmental Policy Act (NEPA) Environmental Impact Assessments
- Federal and state cooperators
 - USFS, BLM, NPS, EPA Region 8, CDPHE, UTDEQ, WYDEQ

Project Timeline



Major Deliverables

- **Modeling Platforms**

- Modeling input/output data, software, and scripts
- 2008 version A and B
 - SMOKE and CAMx
 - Base and Future Year (2020)
- 2011 version A
 - WRF, SMOKE, and CAMx
 - Base and Future Year (2020)
- 2104 in development

- **Emissions**

- 2011 O&G inventory
- Data updates for 3-state sources
- 2008, 2011, 2020 inventories
 - Fusion of NEI and 3-state inventories

- **Monitoring Network Assessment**

Major Deliverables

- Key Analysis Products

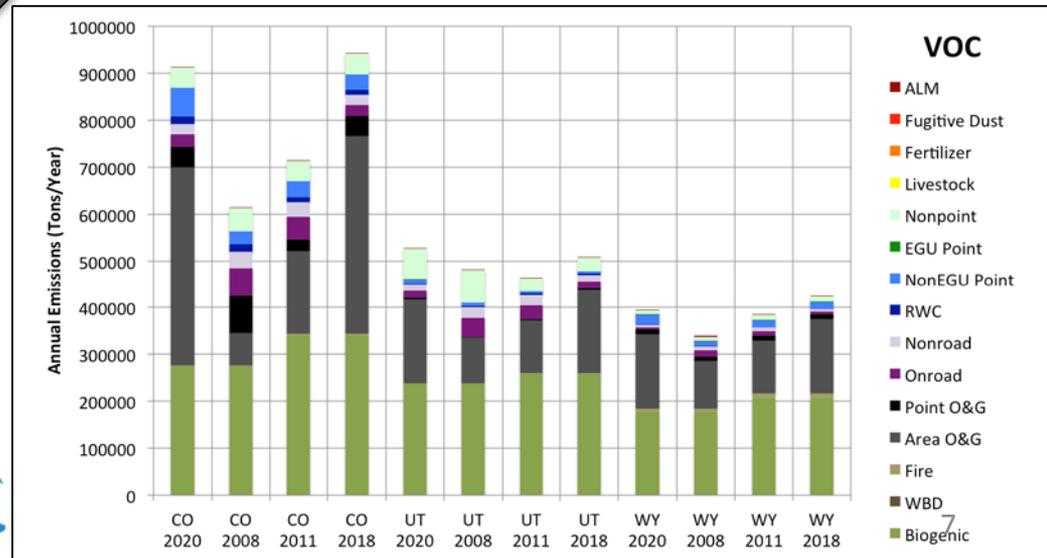
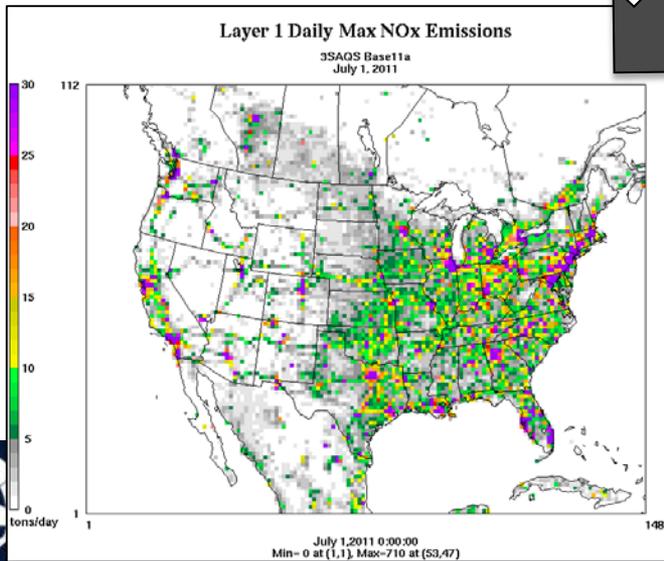
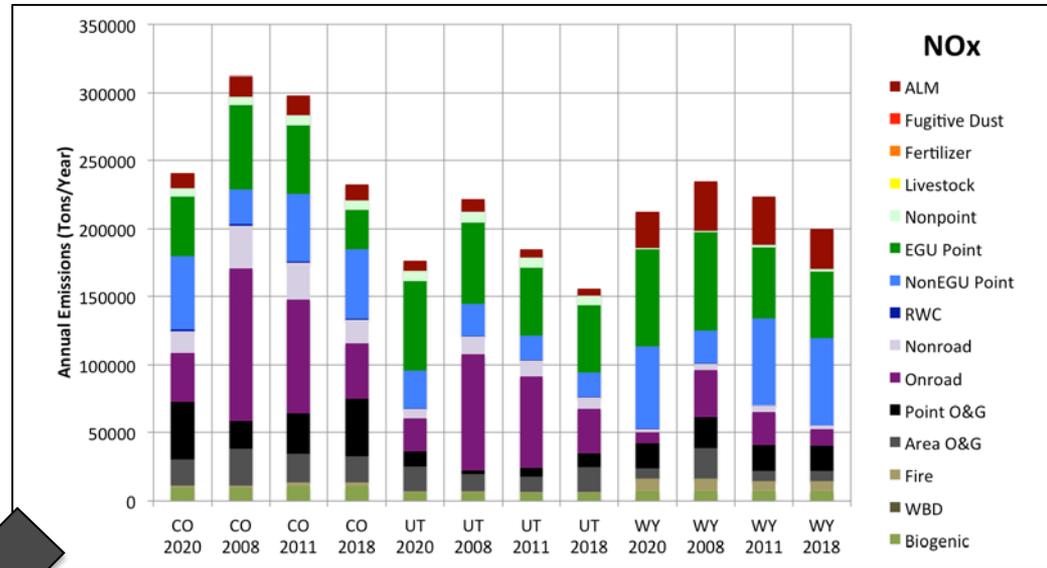
- Inventory comparisons
- VOC reactivity analysis
- Model performance evaluations
 - CAMx 2008
 - WRF 2011
 - CAMx 2011
- Methane inventory analysis

- Modeling Sensitivities

- Boundary conditions
- US background air quality
- Ammonia emissions
- Oil and gas emissions
- Winter ozone

Key Findings: Emissions

- New 2011 O&G EI
- 2008 > 2011 > 2020
 - Trends vary by state/sector/pollutant
 - General decrease in emissions through time
 - Exception is VOC from O&G sources



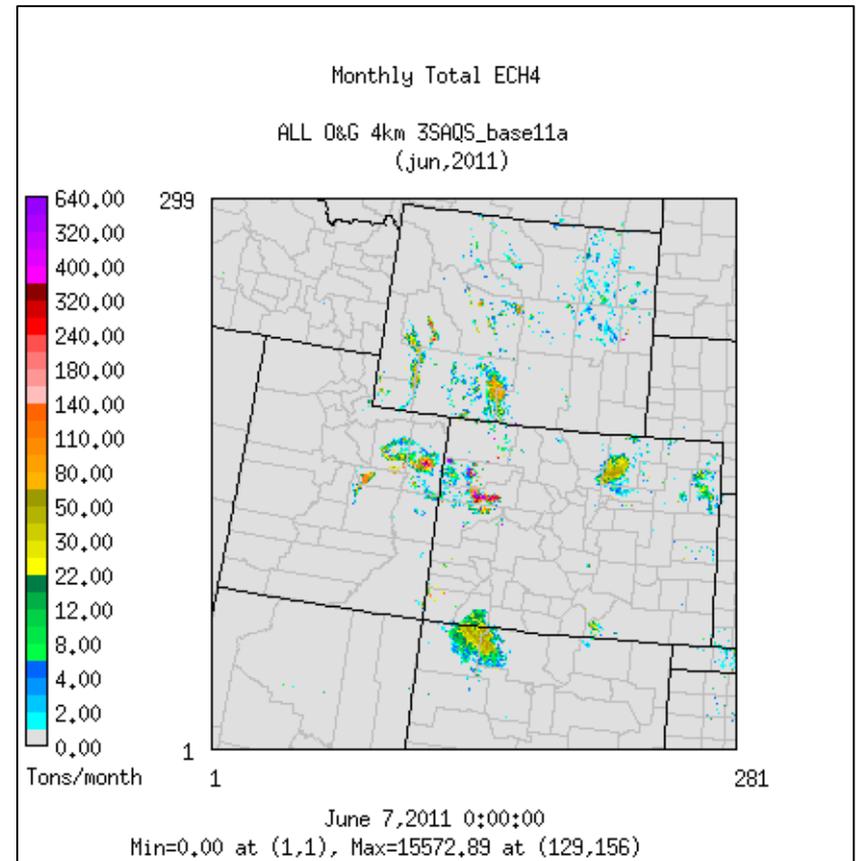
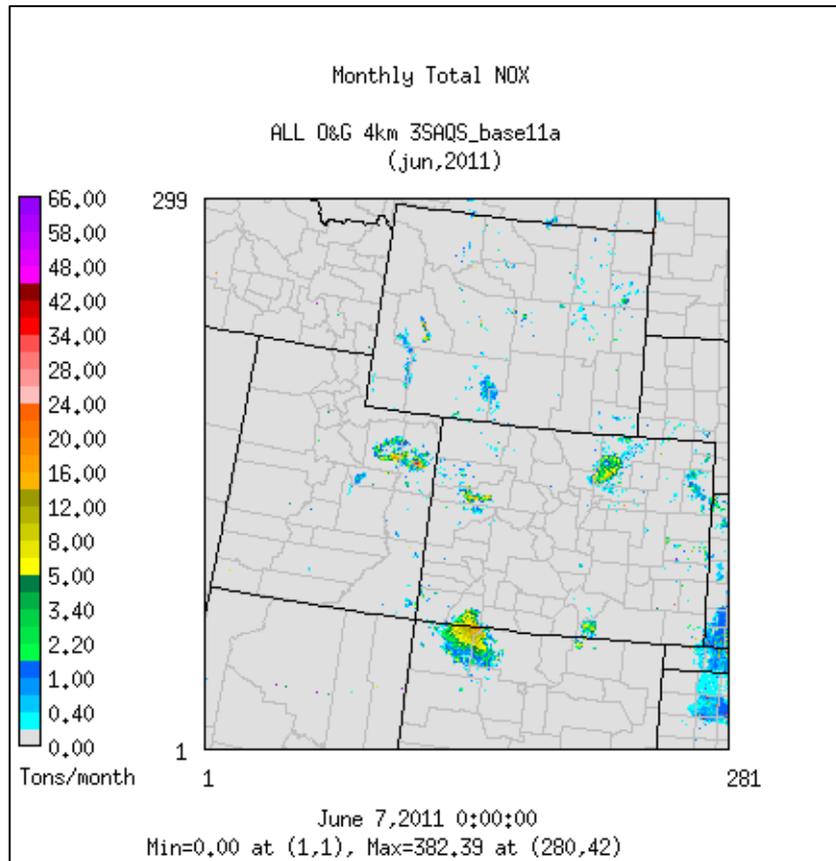
Key Findings: Emissions

- Collaboration with CO, UT, WY state DAQs to obtain data, review emissions, and get feedback on protocols/evaluations
- Updates to key sectors/pollutants
 - Agricultural NH₃ – point CAFO locations used to improve the spatial allocation of livestock emissions
 - On-road mobile – link-based VMT from CO used to improve spatial allocation of on-road mobile sources in CO
 - Review of 3SAQS updates to temporal and chemical speciation profiles for nonroad and nonpoint sources
 - Updated oil and gas source inventories for base and future years

Oil and Gas Emissions Development Activities

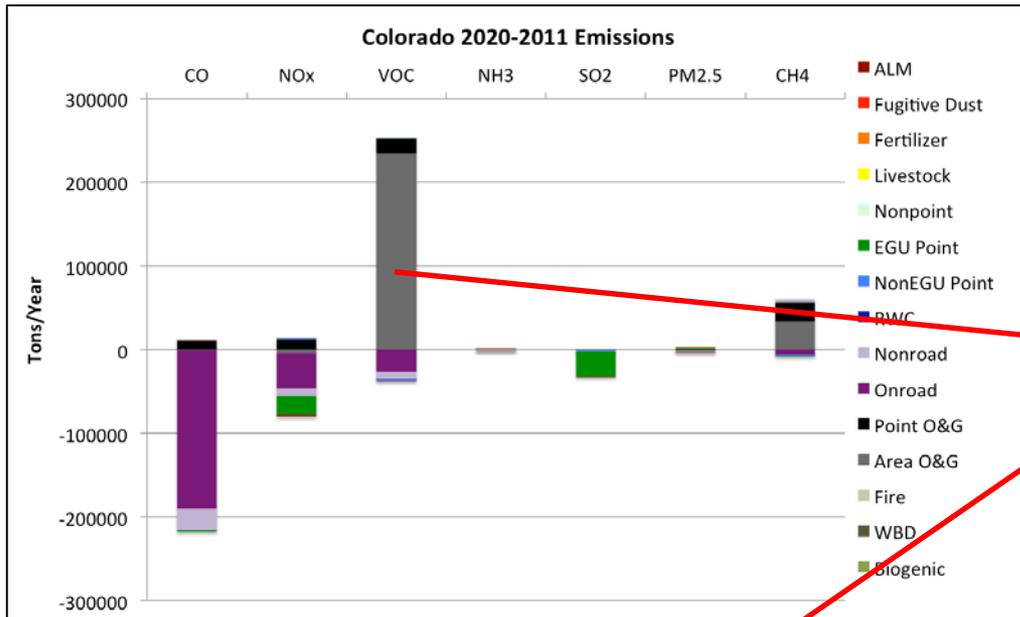
- 2011 base year inventories developed for all major basins in the 3 states
 - Uinta (UT)
 - Piceance (CO)
 - D-J (CO)
 - All Wyoming Basins (WY)
 - Raton Basin (CO/NM)
 - Paradox Basin (UT)
 - South San Juan Basin (NM)
- 2020 projections developed for all basins
- 2011/2020 emissions processed through SMOKE and model-ready

Example Processed and Gridded O&G Emissions

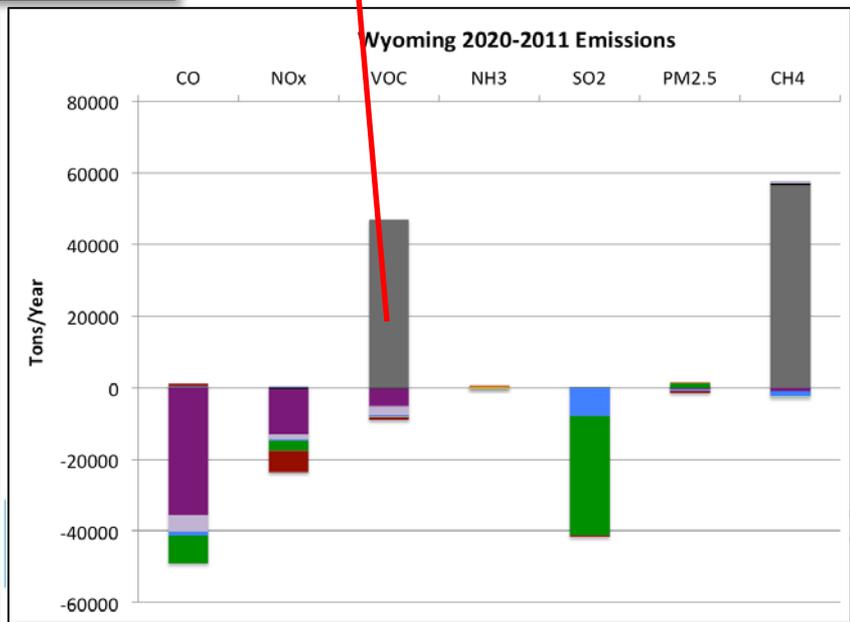
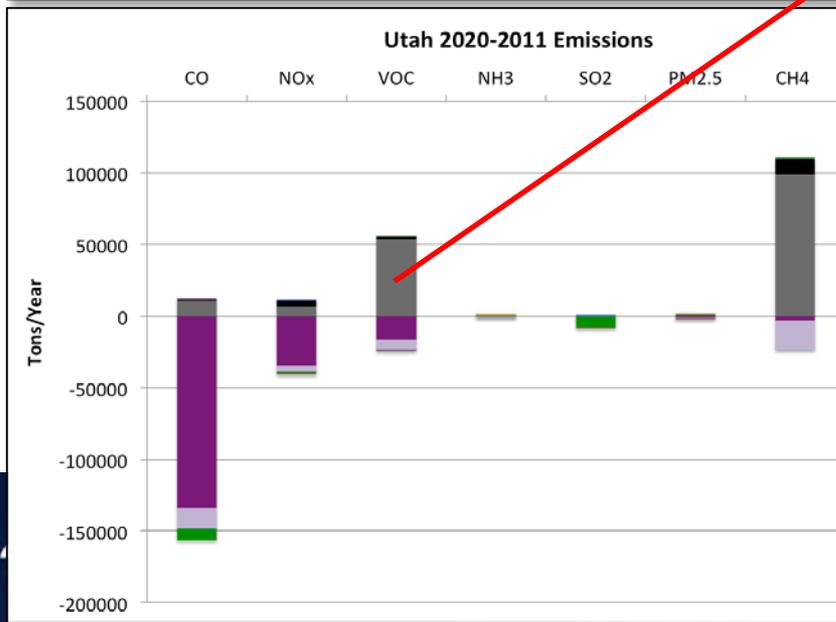


June 2011 gridded oil and gas emissions in 4-km modeling domain

Key Findings: Emissions



- 2020 – 2011 Emissions
 - Mostly decreases for all sectors/pollutants/states **except O&G VOC/TOG**
 - Plots show differences by state (CO, UT, WY)



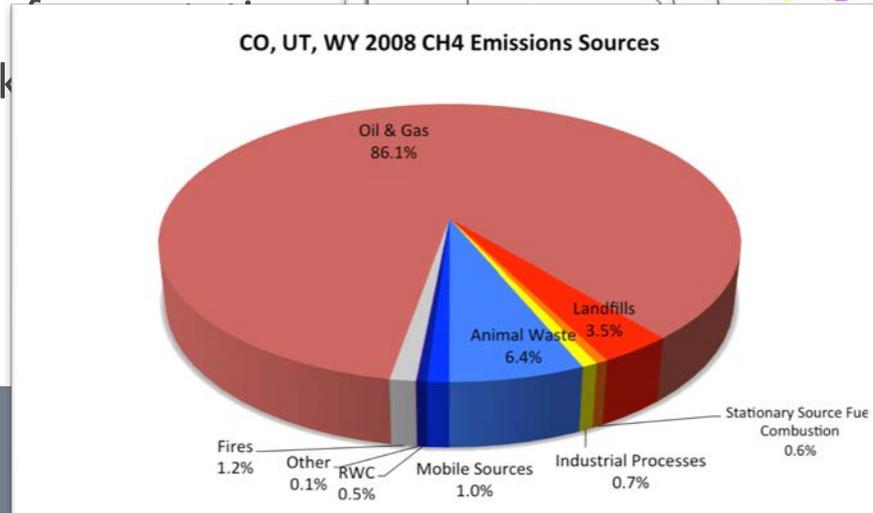
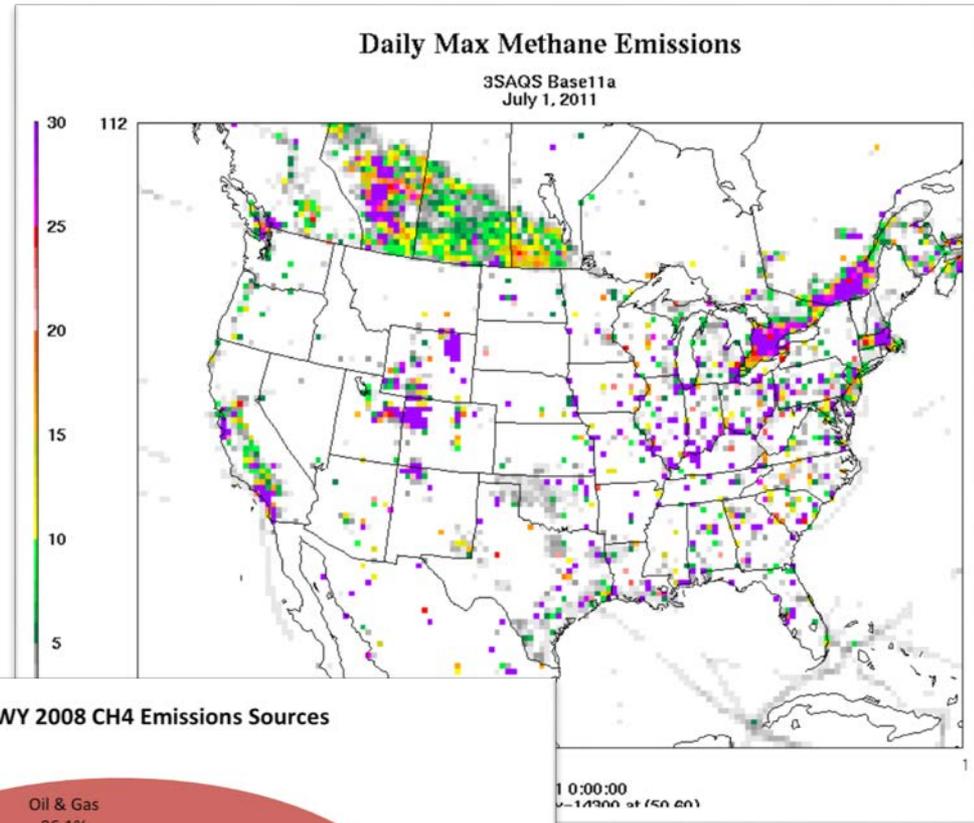
Emissions Modeling Report

- Detailed description of 3SAQS 2008 and 2011 emissions modeling platforms
 - Data sources
 - Data preparation
 - Modeling
- Summaries by state (and county for 2011)
- Inventory comparisons
 - 2008 vs 2011
 - Base vs future
- Analysis of the inventory changes from 2008 to 2011
- Available on the Data Warehouse

Key Findings: Emissions

- Methane

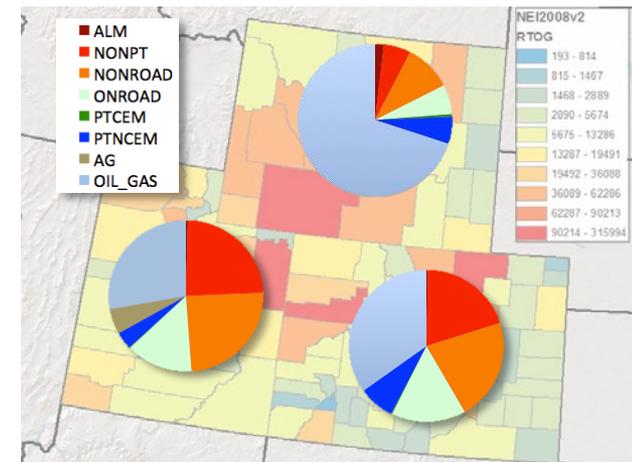
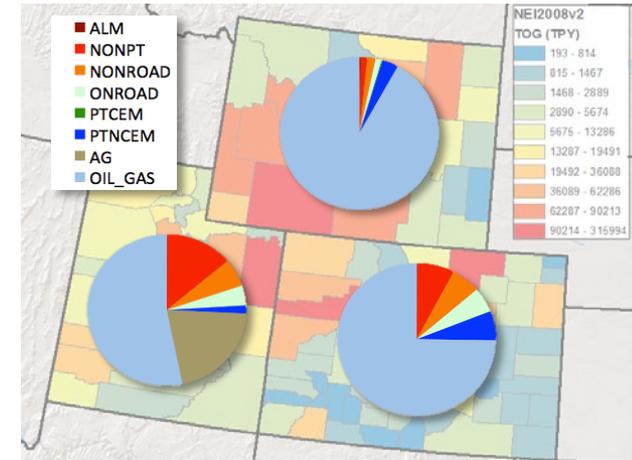
- 3SAQS one of the first U.S. regional CTM studies to look at active methane emissions
- Tracer for important regional emissions sectors (O&G and ag)
- O&G is the largest source in the current inventory
- Missing significant agricultural sources: enteric and livestock



Key Findings: Emissions

- Emissions Reactivity

- Reactivity-based analysis of inventories focuses on sources with greatest ozone formation potential
- Different sources are dominant using reactivity weighting vs. mass-based analysis
- Reactivity analysis is dependent on validity of inventory and chemical speciation

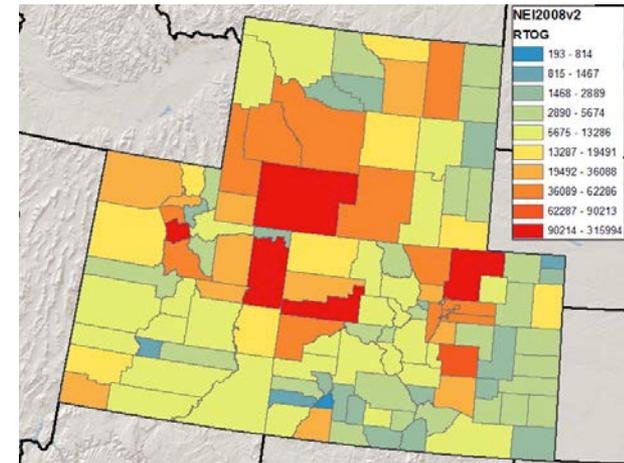
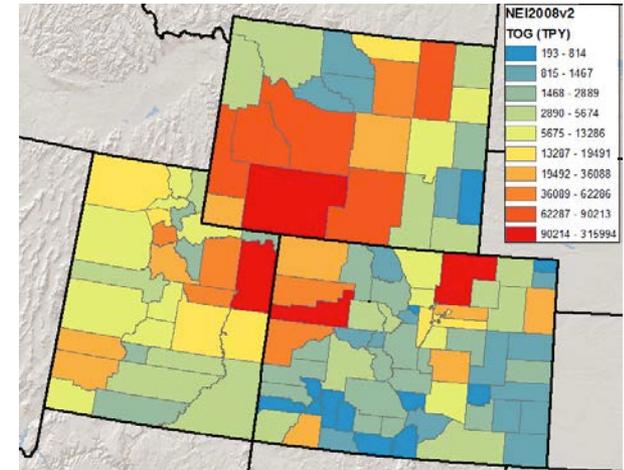
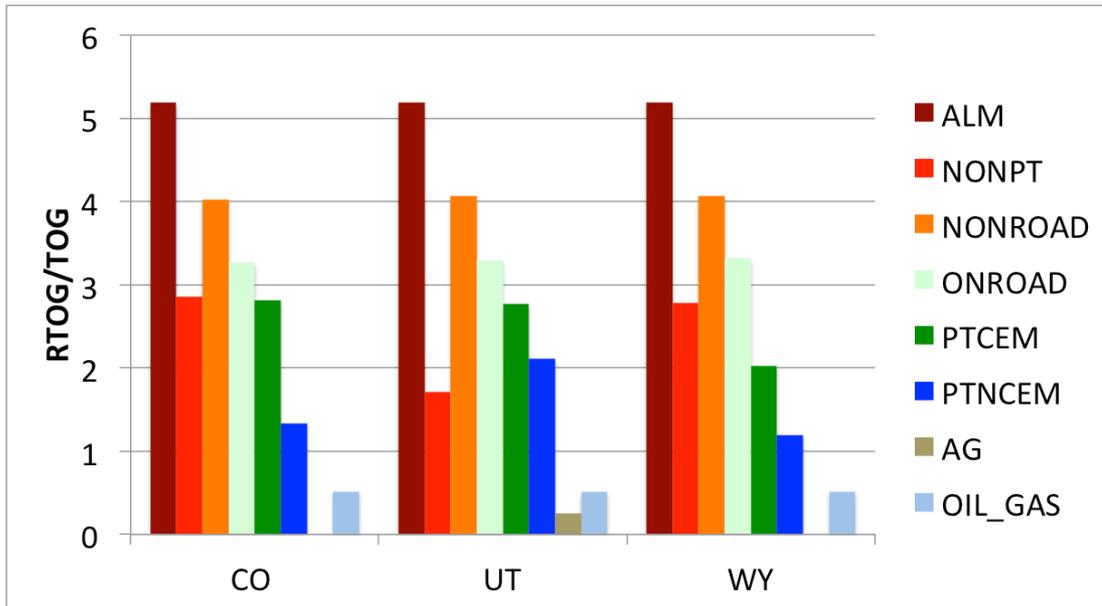


Key Findings: Emissions

Emissions Reactivity

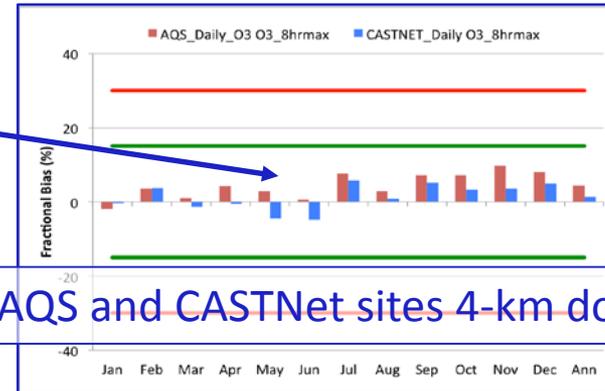
$RTOG = TOG * \text{Profile Total MIR}$

$RTOG/TOG = \text{Relative emission reactivity}$

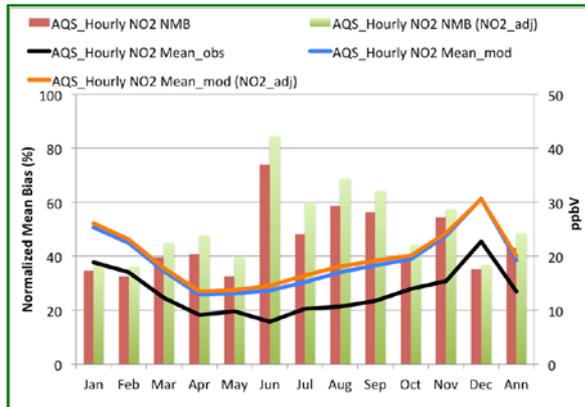


3SAQS Base 2011a MPE

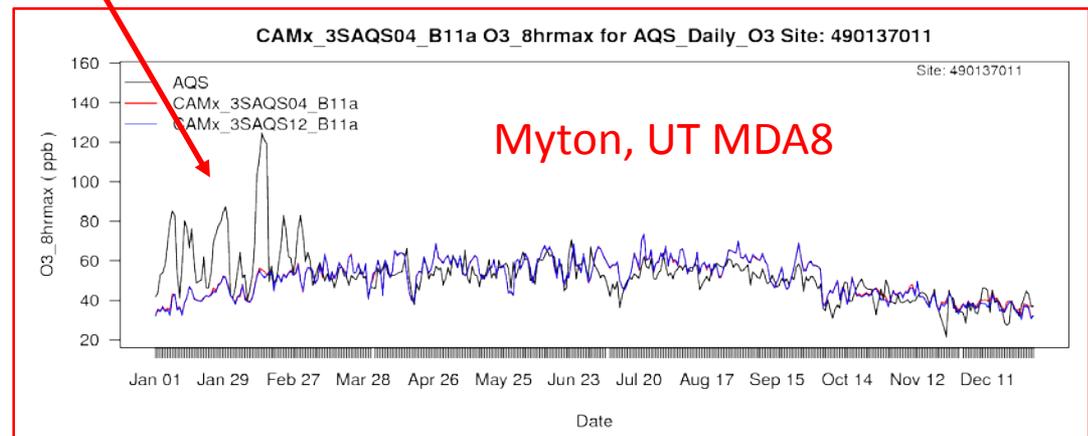
- 2-slide summary of 2011a MPE
- Summer O₃ OK
- Too little winter O₃
- Too much NO₂



All AQS and CASTNet sites 4-km domain

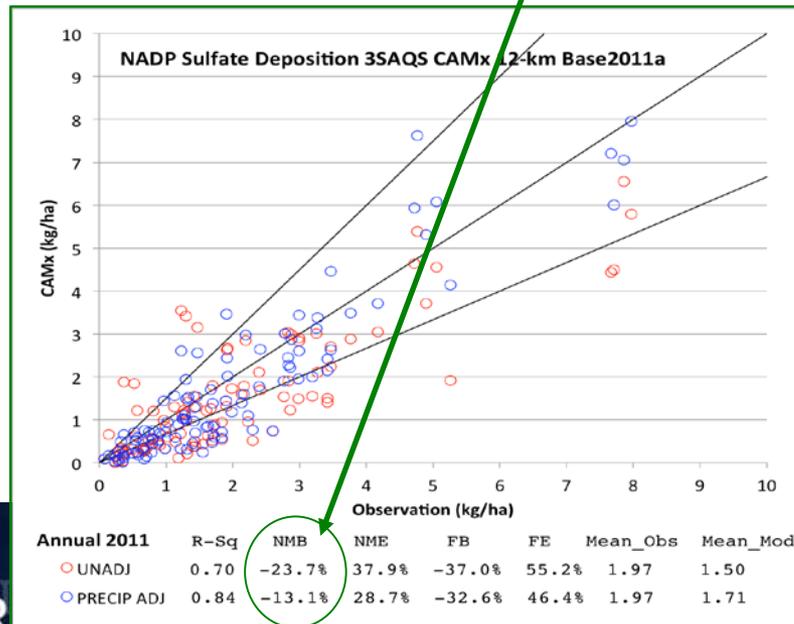
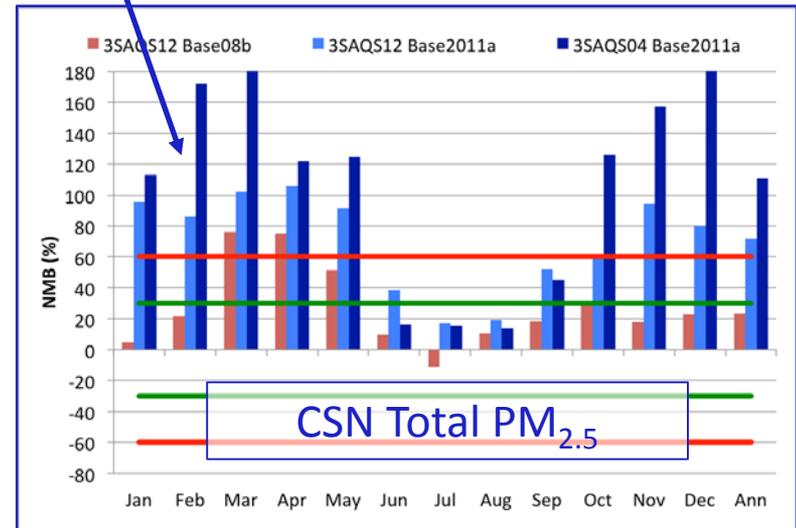
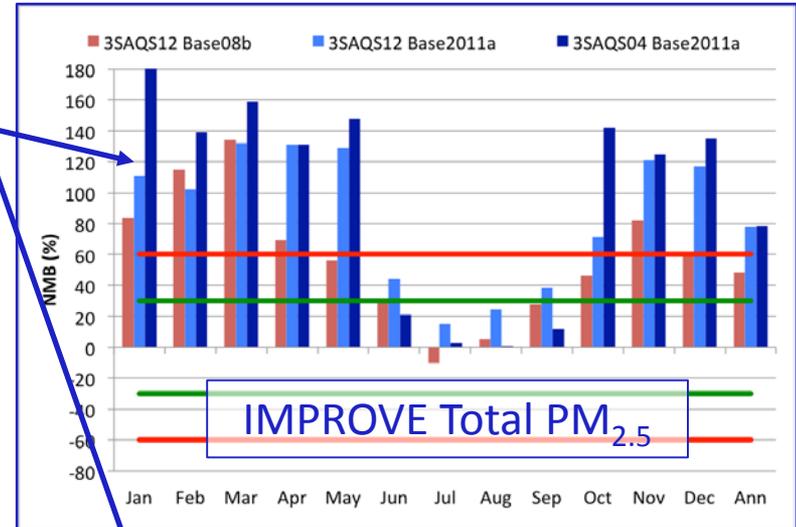


Colorado AQS NO₂



3SAQS Base 2011a MPE

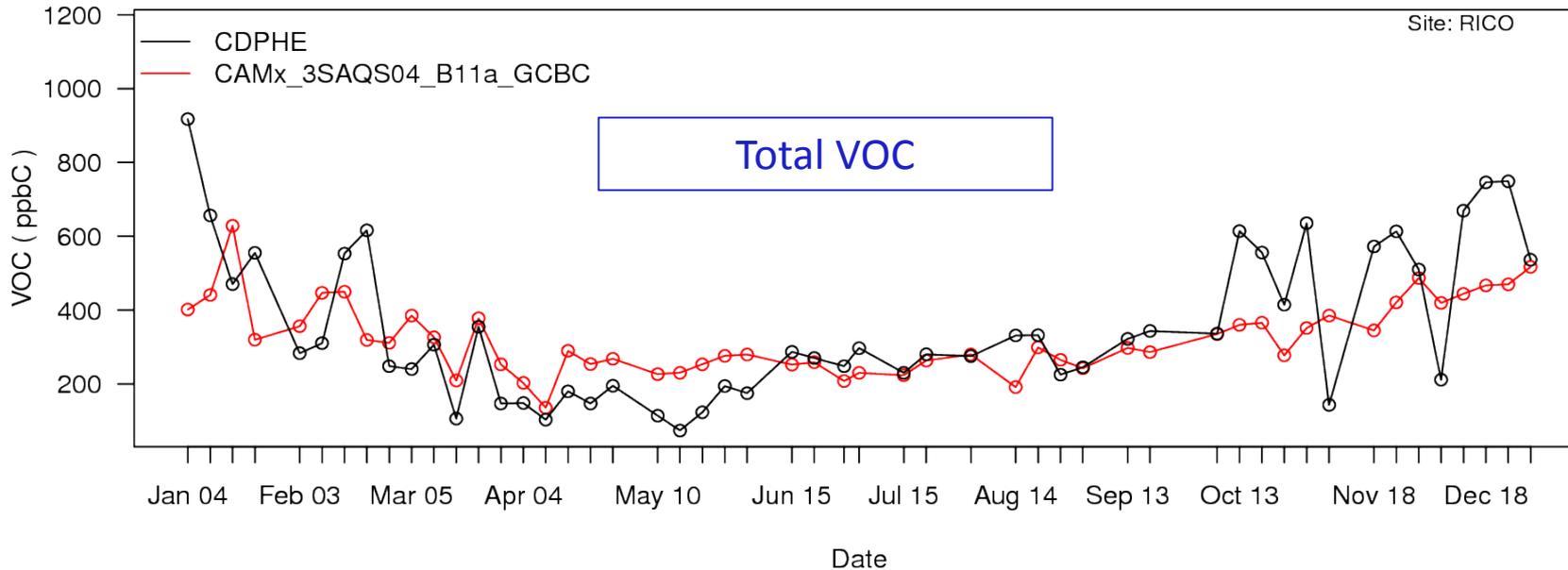
- High seasonal $PM_{2.5}$ bias
- PM performance issues with all species
- Wet deposition too low



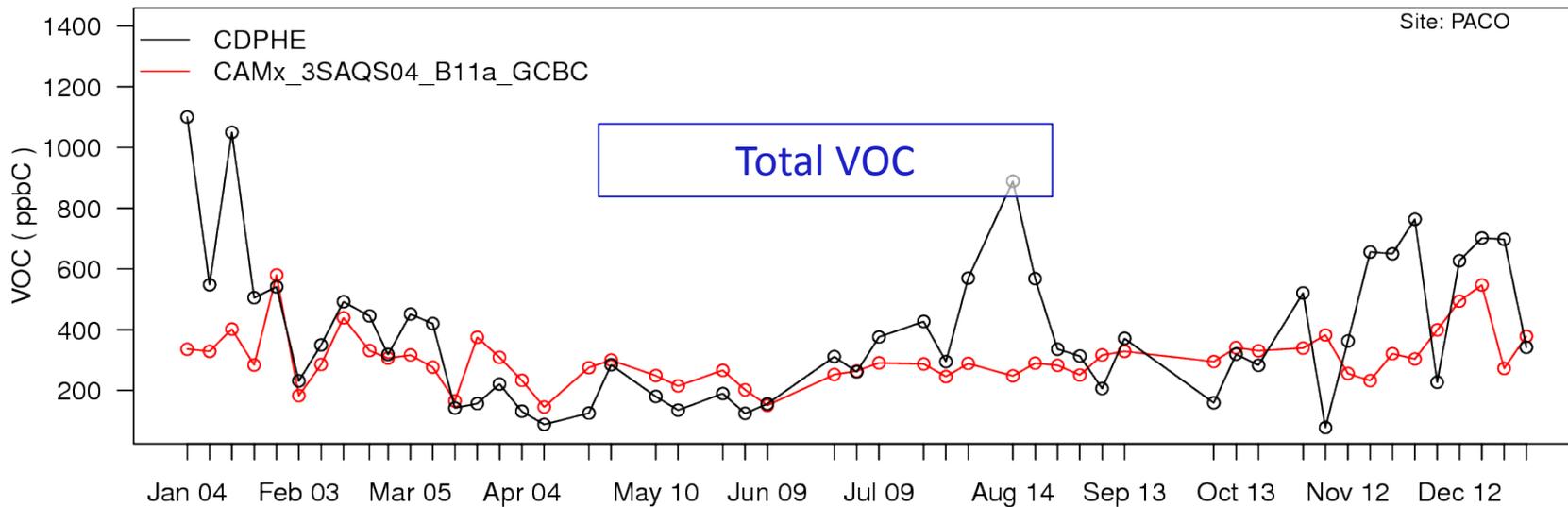
Garfield County, CO VOCs

- 4 Locations in Garfield County with speciated VOC measurements in 2011 ([monitor map](#))
 - Parachute (PACO) – small urban location, close to O&G development/production; transportation hub
 - Rifle (RICO) – urban center, close to O&G development/production; industrial hub
 - Bell-Melton (BRCO) – rural site, near O&G development locations
 - Battlement Mesa (BMCO) – rural site, near large natural gas development locations

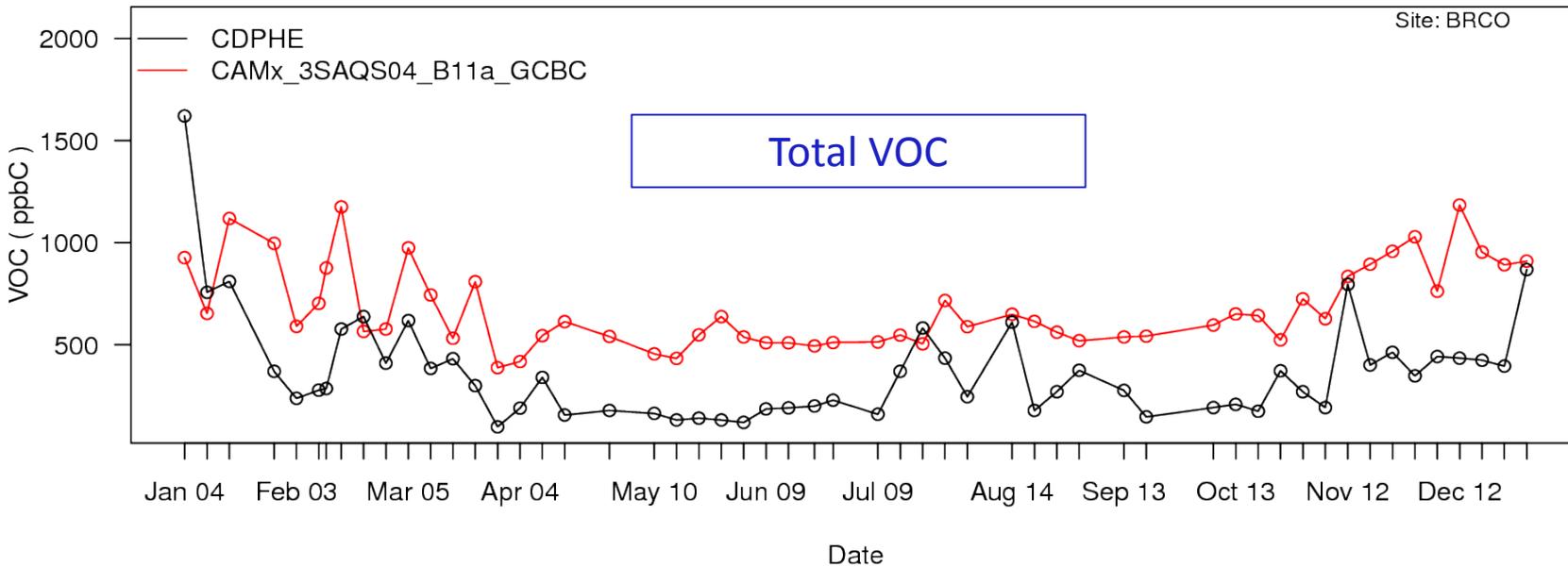
CAMx_3SAQS04_B11a_GCBC VOC for CDPHE Site: RICO



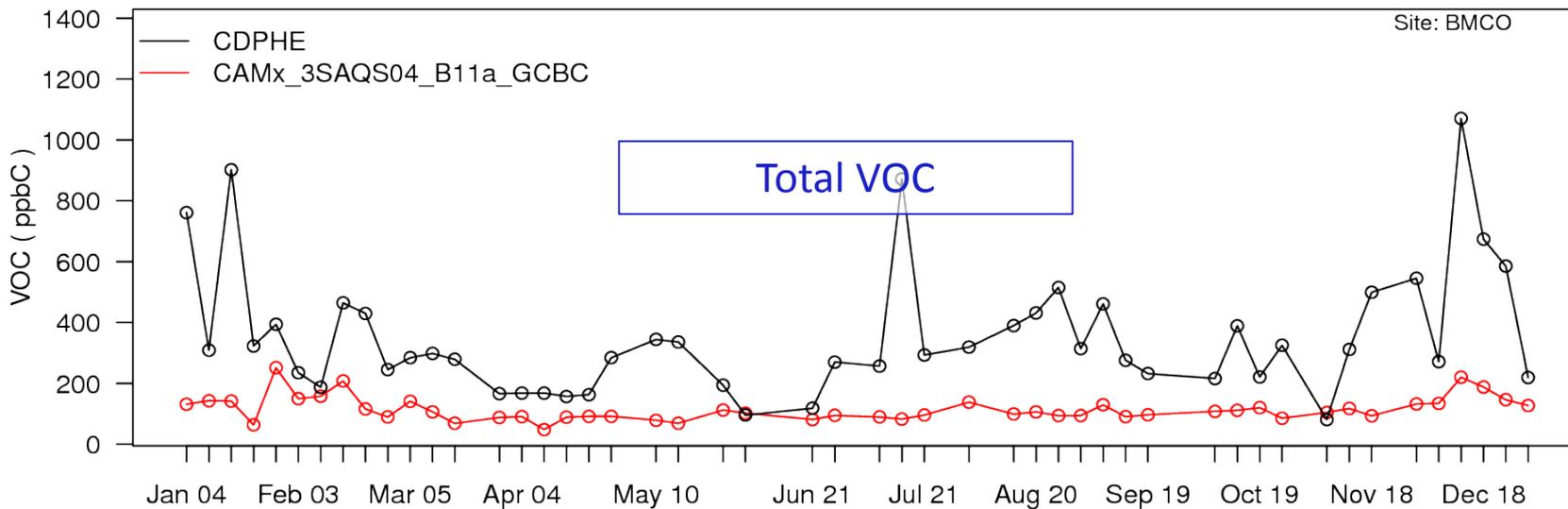
CAMx_3SAQS04_B11a_GCBC VOC for CDPHE Site: PACO



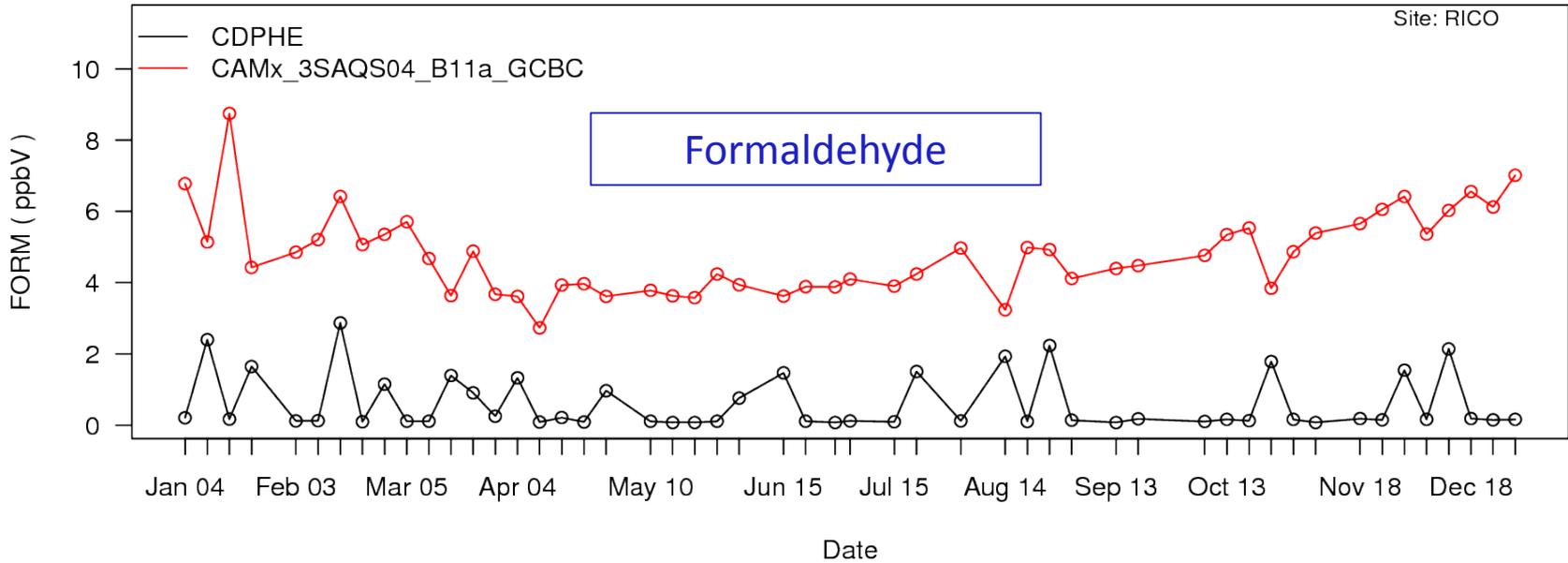
CAMx_3SAQS04_B11a_GCBC VOC for CDPHE Site: BRCO



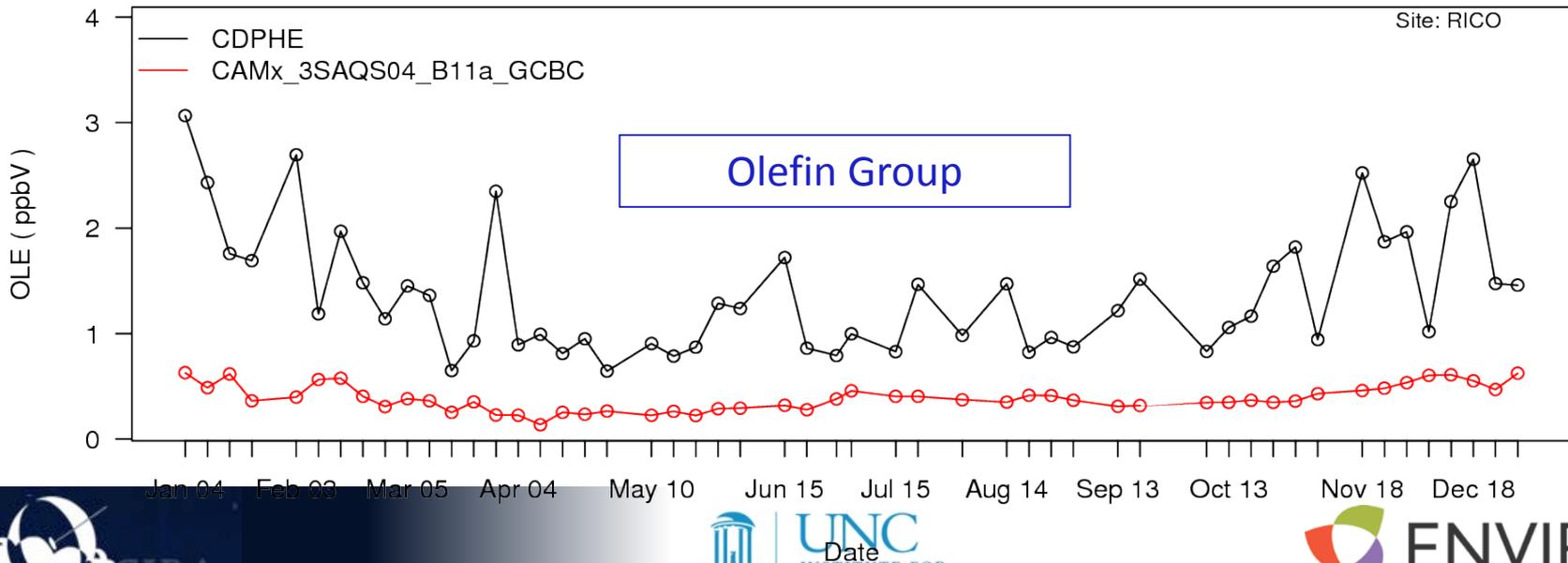
CAMx_3SAQS04_B11a_GCBC VOC for CDPHE Site: BMCO



CAMx_3SAQS04_B11a_GCBC FORM for CDPHE Site: RICO



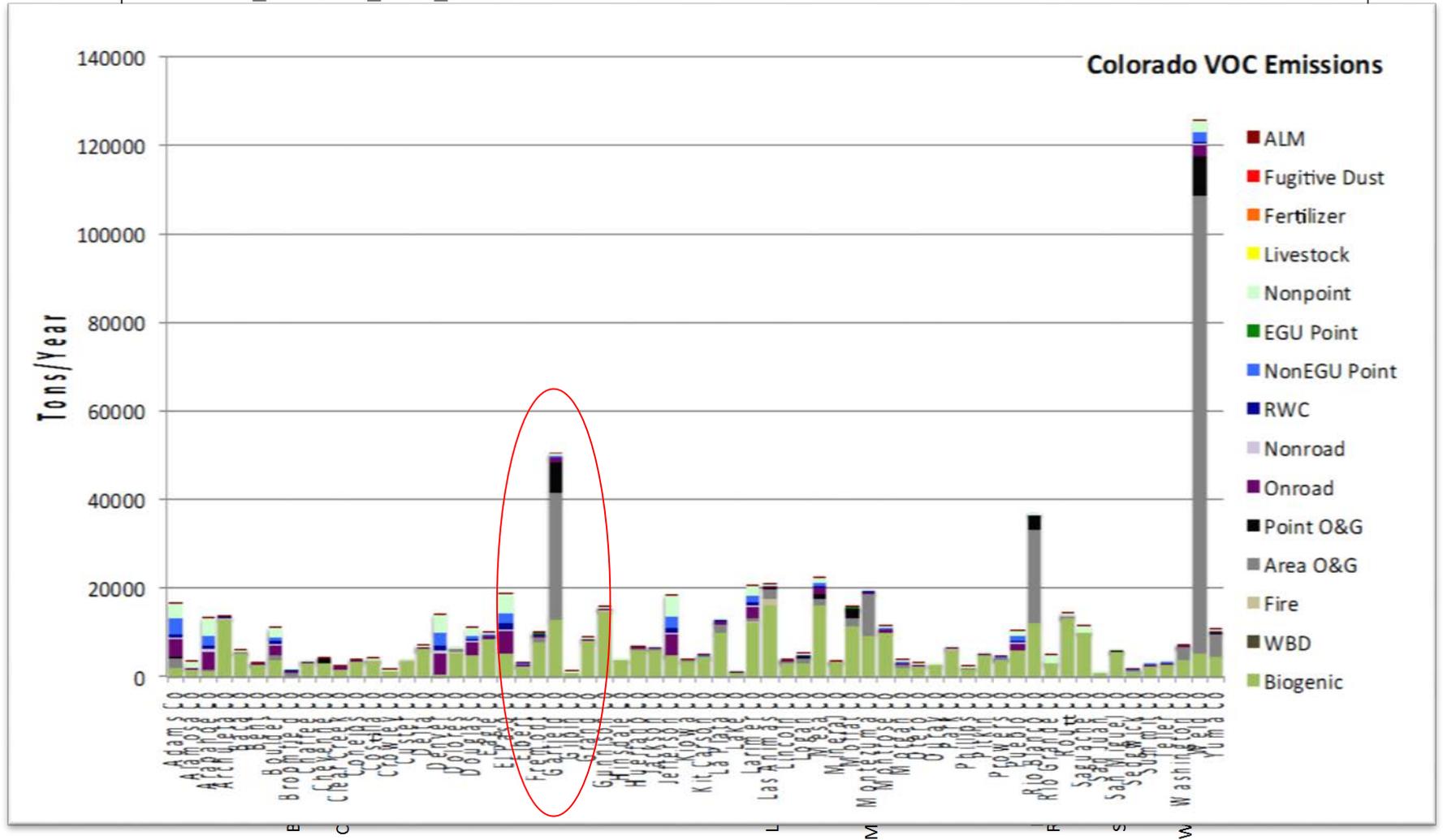
CAMx_3SAQS04_B11a_GCBC OLE for CDPHE Site: RICO



CAMx_3SAQS04_B11a_GCBC FORM for CDPHE Site: RICO

Site: RICO

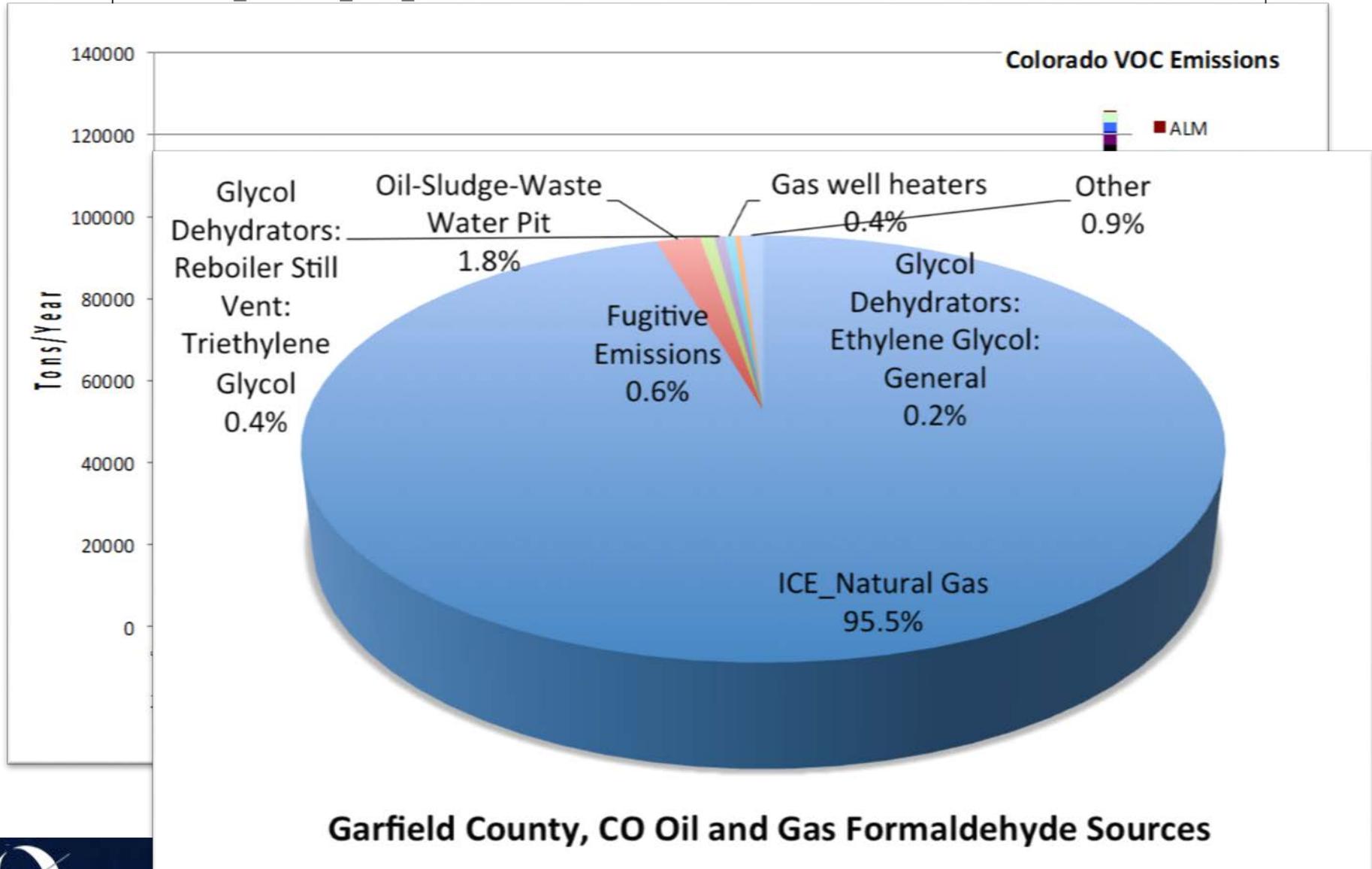
10 — CDPHE
 — CAMx_3SAQS04_B11a_GCBC



CAMx_3SAQS04_B11a_GCBC FORM for CDPHE Site: RICO

Site: RICO

10 — CDPHE
CAMx_3SAQS04_B11a_GCBC



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The Western Air Quality Data Warehouse provides air quality data and analysis tools to support regulatory, research, and academic applications. Available datasets include emissions inventories, meteorological data, monitoring data, and air quality modeling platforms. Available modeling platforms support consistent photochemical grid modeling for National Environmental Policy Act projects and other modeling studies.

GET DATA

Access a wide variety of monitored, modeled, emissions, and met data.

DOCUMENT NEEDS REVIEW !

WSAQs Weather Research Forecast (WRF) Winter Modeling Workplan

DOCUMENT NEEDS REVIEW !

3SAQS WRF 2011 Meteorological Model Performance Evaluation

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