Building Comprehensive Quality Assurance for the Air Toxics and Ozone Precursors Monitoring Program at the State of Colorado's APCD

Ashley Collier-Oxandale, Robert Summers, Nathan Bradley, Steve Szocik, Leah Gibson, Erik Joplin, Annette Carlson, & Jason Schroder

National Ambient Air Monitoring Conference, August 2024

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

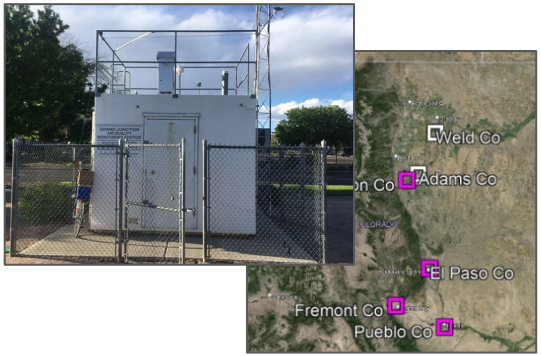
Overview

I. ATOPs Overview & DAQ Unit
II. Building a QA Program
III. Building a Data Processing and Validation Solution

Air Toxics and Ozone Precursors Program (ATOPs)

Est. Dec. 2022

Stationary Air Toxics



Time-integrated sampling, NATTS/COATTS (VOCs, metals, PAHs, carbonyls)

Mobile Air Toxics

High-time resolution data, mobile and stationary (Eiger PTR-MS, AIM Chemical Ionization Time-of Flight MS, Picarro, Micro-GC)

Oil & Gas Mobile Monitoring

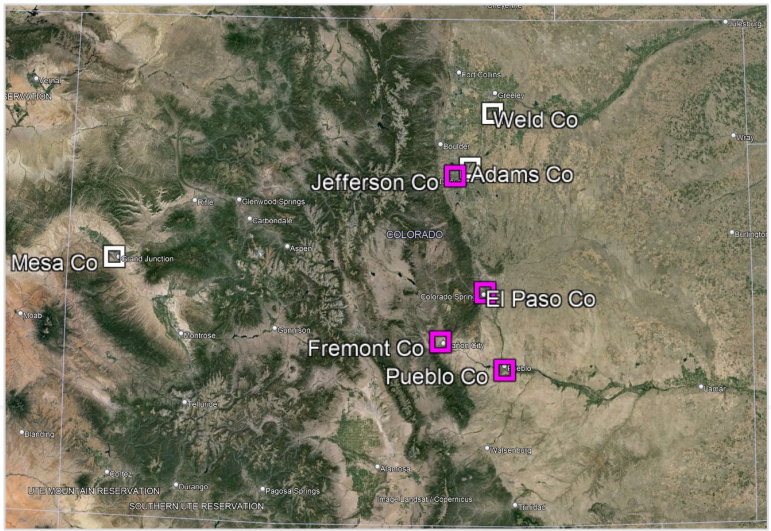
High-time res. data, (open-path optical instruments, conventional GC, Micro-GC, sensors and canisters)

Data & QA Unit

Air Toxics Monitoring Database, data dashboards, data access

Overview: Stationary Air Toxics (SAT)

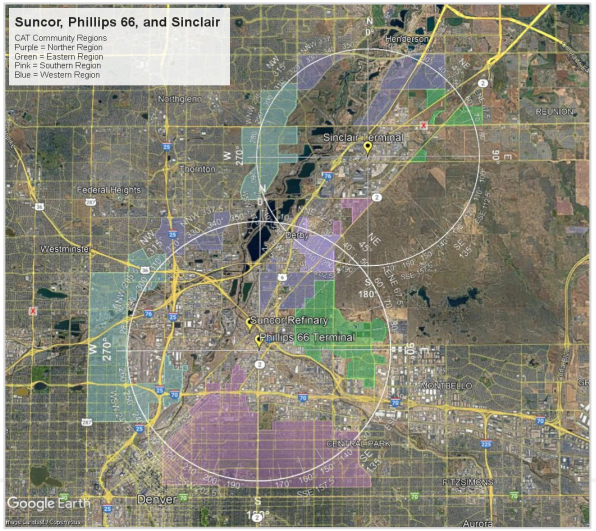
- NATTS - National Air Toxics Trends Station
  - Grand Junction site, in operation since 2004
- COATTS - Colorado Air Toxics Trends Station
  - **Public Protections from Toxic Air Contaminants** (HB22-1244): expands Colorado's air monitoring for air toxics (operated as NATTS sites)
    - Phase 1: 3 sites in 2024
    - Phase 2: 4 sites in 2025
- COOPS - Colorado Ozone Precursor Sites
    - Four fixed locations
    - 81 VOCs, 3-hr samples every 6th day



COLORADO
Air Pollution Control Division
Department of Public Health & Environment

Overview: Mobile Air Toxics (MAT)

- Monitoring Assets
  - Community Air Toxics (CAT) Mobile Van
  - Emissions Monitoring Utility (EMU) Mobile Van
  - Mobile Air Remote Monitoring Trailers (MARMOTs)
- Colorado Air Toxics Act (HB21-1189)
  - Monitoring of 3 toxic gasses (benzene, hydrogen cyanide, and hydrogen sulfide)
  - In the communities surrounding 4 covered facilities (within a 3 mile radius)
  - Monitoring completed primarily by the CAT, driving repeated routes



Overview: Oil & Gas Mobile Monitoring (OMM)

Monitoring Assets

- Mobile Optical Oil & Gas Sensor of Emissions (MOOSE)
- Colorado Air Monitoring Mobile Lab (CAMML)
- Pyxis Micro-GC and AROMA VOC
- SENSIT SPODs

Objectives

- Provides monitoring around oil and gas
- Aimed at measuring emissions reaching nearby residential areas
- OMM group works with the Toxicology and Environmental Epidemiology (TEEO) as part of the Oil and Gas Health Information and Response (OGHIR)
- Program to investigate complaints from the public

Overview: Data & Quality Assurance (DAQ)

Quality Assurance

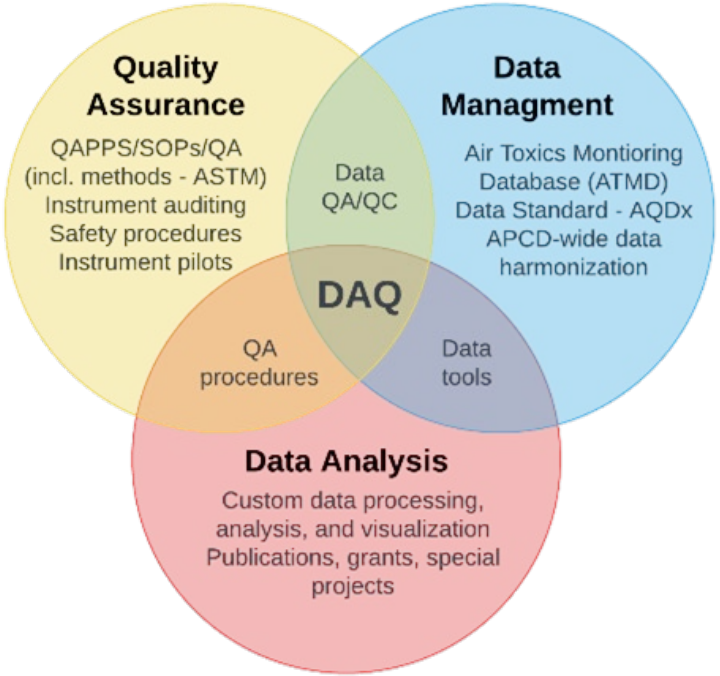
- Ensure high quality data is collected by conducting periodic instrument audits
- QA review/approval of data

Data Management

- Manage and maintain the Air Toxics Monitoring Database (ATMD)
- Coordinate data sharing outside of ATOPs

Data Analysis

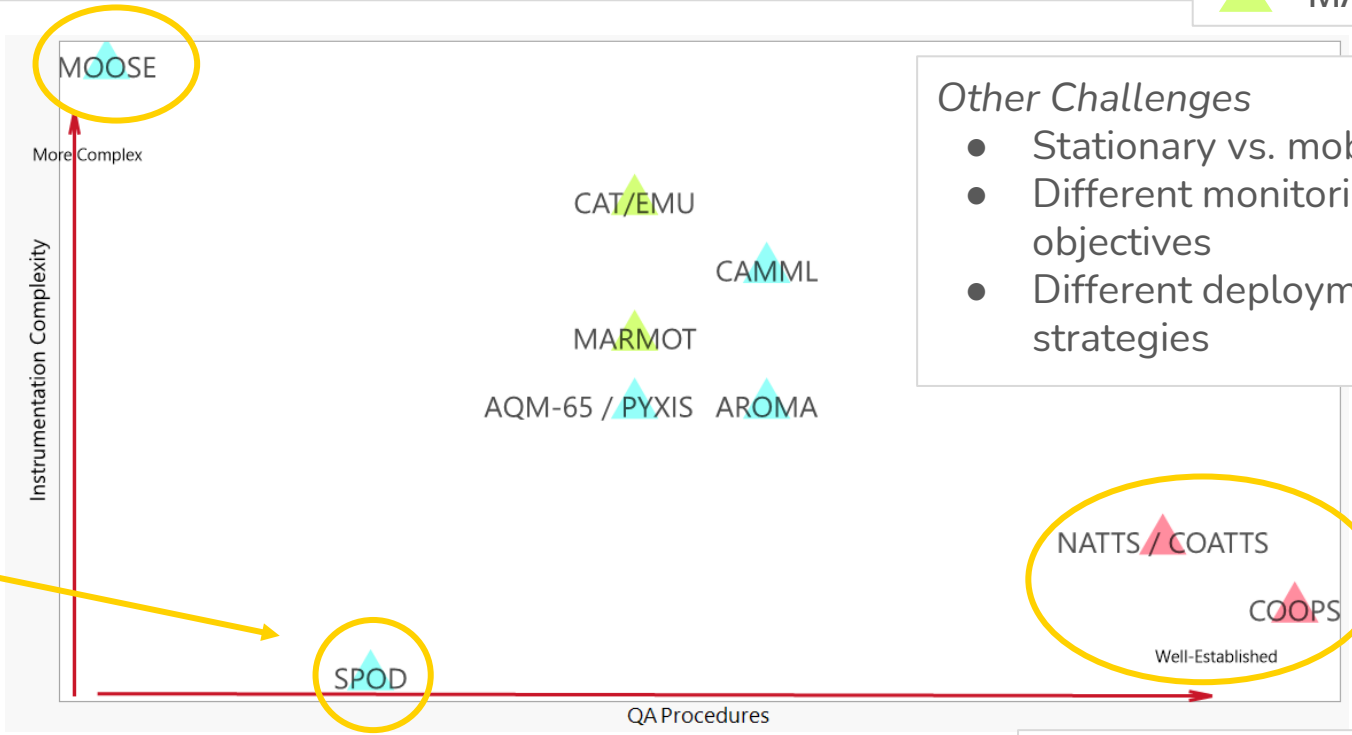
- Support and assist ATOPs and the APCD in data processing, analysis, and visualization efforts
- Communicating key takeaways to the public



Key Challenges

SAT
OMM
MAT

Highly-novel open-path optical instruments



Other Challenges

- Stationary vs. mobile
- Different monitoring objectives
- Different deployment strategies

Low-cost sensors

Long-running stationary sampling methods

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

AIR TOXICS & OZONE PRECURS

Quality Assurance Components

Audits, calibration, and determination of detection limits

- Internal at this point, but independent from asset operators
- Includes auditing of sampling equipment and monitoring instruments, auditing/calibration of flow meters and controllers, and tracking of recurring maintenance and calibration for other ATOPs equipment

Documentation

- QAPPs developed at the asset-level (as opposed to program-level) due to different monitoring objectives and wide range of instrumentation
- Organization/development/review of other documentation

Data Review and Approval

- Interim/manual processes in place, ATMD will offer standardization
- Need robust QA procedures for ATMD (i.e., auditing the QA/QC workflows)

QA Examples

NATTS/COATTS - existing

Quarterly Performance Audits
- As specified in the TAD for VOC (ATEC), PAH (PUF), Carbonyl (ATEC), and metals (PM10 filters) sampling devices

Documentation
- Operating and audit SOPs, audit forms, QAPPs following NATTS format, corrective action reports (based on requirements in TAD)

Data Review and Approval
- ATMD for auto and manual QA/QC for data from laboratory

CAT/EMU - new protocols

Quarterly Performance Audits
- For continuous instruments (zeros, specified set points, and audit MDL calculations using 40 CFR)
- Additional checks (e.g., checks for meteorological instruments, incl. GPS)

Documentation
- Operating and audit SOPs, audit forms, asset QAPPs modelled on APCD TSP format, corrective action reports

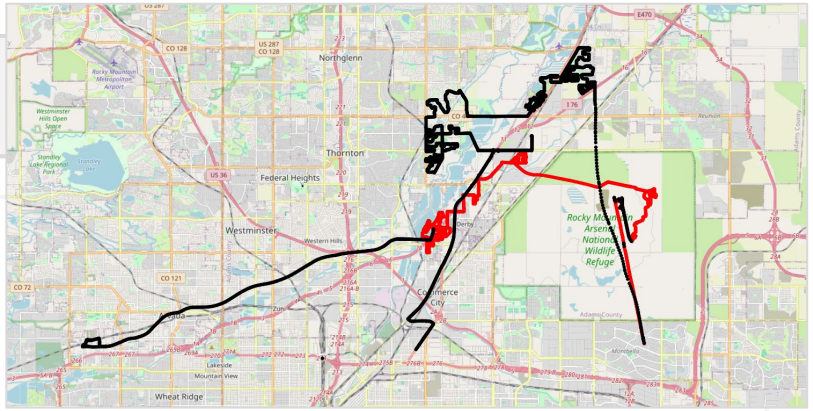
Data Review and Approval
- ATMD for deployment data
- Internal solution for audit processing and verification

QA Examples - CAT/EMU Mobile Lab

- Metrics modelled on those applied to continuous criteria pollutant monitors
- Audit levels based on Colorado's Health Guideline Values (HGVs) and level 1 8-hr AEGL limits (i.e., designed to target levels of concern to human health)
- Have internal code/UI to standardize processing of audit data

Check	Acceptance Criteria
Percent difference of audit levels (accuracy)	< +15.1%
Percent recovery of audit levels	+/- 30% of 100%
Zero check	< 3x the audit MDL & less than HGV
Relative percent difference of steady state period (precision)	< +15.1%
Audit/calculated MDL check (sensitivity)	< ⅓ HGV or AEGL limit

Unexpected Challenges



GPS QA/QC

- Issue: mobile monitoring platform GPS instrument was producing incorrect data (off route, off roads, etc.)
- Short-term solution: filter data based on number of satellites (metadata provided by GPS instrument), imperfect - overfiltered
- Long-term solution: code to (1) invalidate points off roads, and (2) flag points off typical route for manual review

Complexity of wind speed/direction data collected by mobile platform

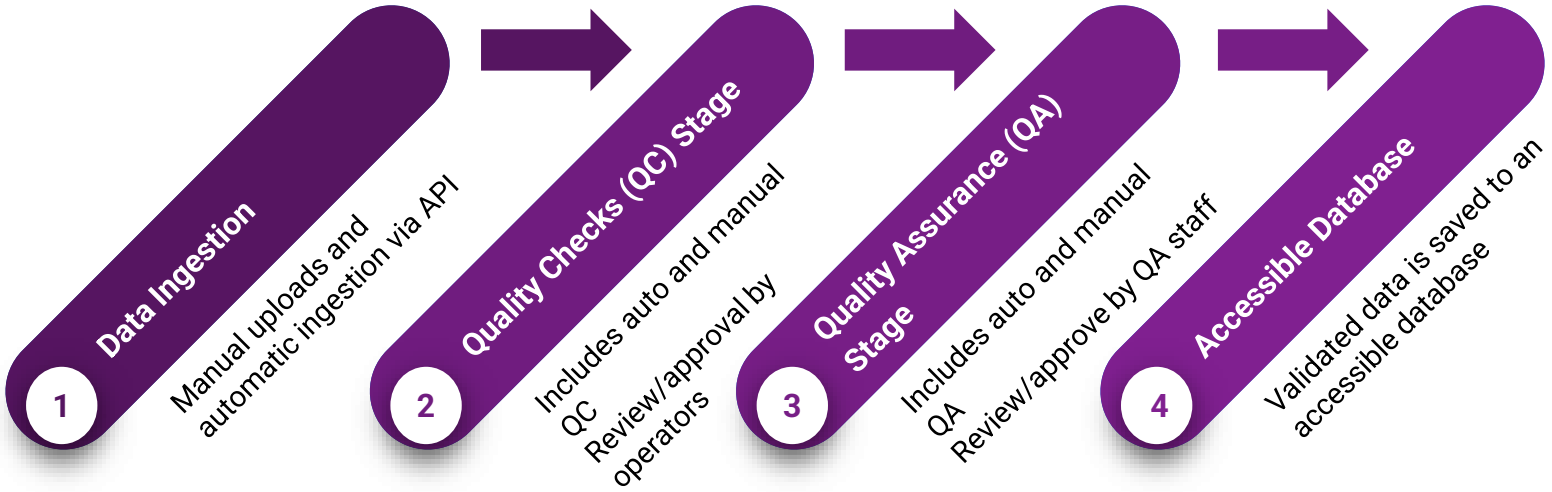
- Aerodynamics seem to influence WS/WD data at vehicle higher speeds
- Solution: informationally flagging data when there is low variability in relative wind direction

QA Lessons Learned

For novel instrumentation/platforms

- Helpful to begin with “pilot audits”, to better inform purchasing and equipment needs
- Model QA procedures and documentation on existing programs where possible
- Build QA Program 1 asset/monitoring platform at a time
- Supplemental monitoring information (i.e., meteorological and GPS may present their own challenges - begin auditing these when auditing air toxics instruments)

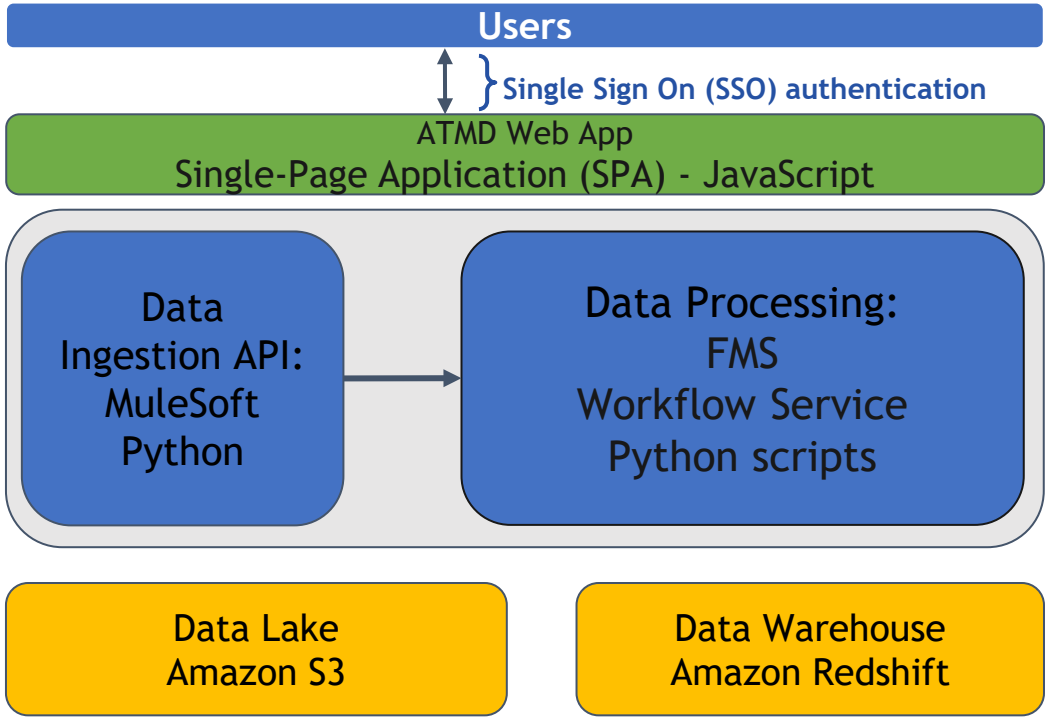
Air Toxics Monitoring Database - ATMD



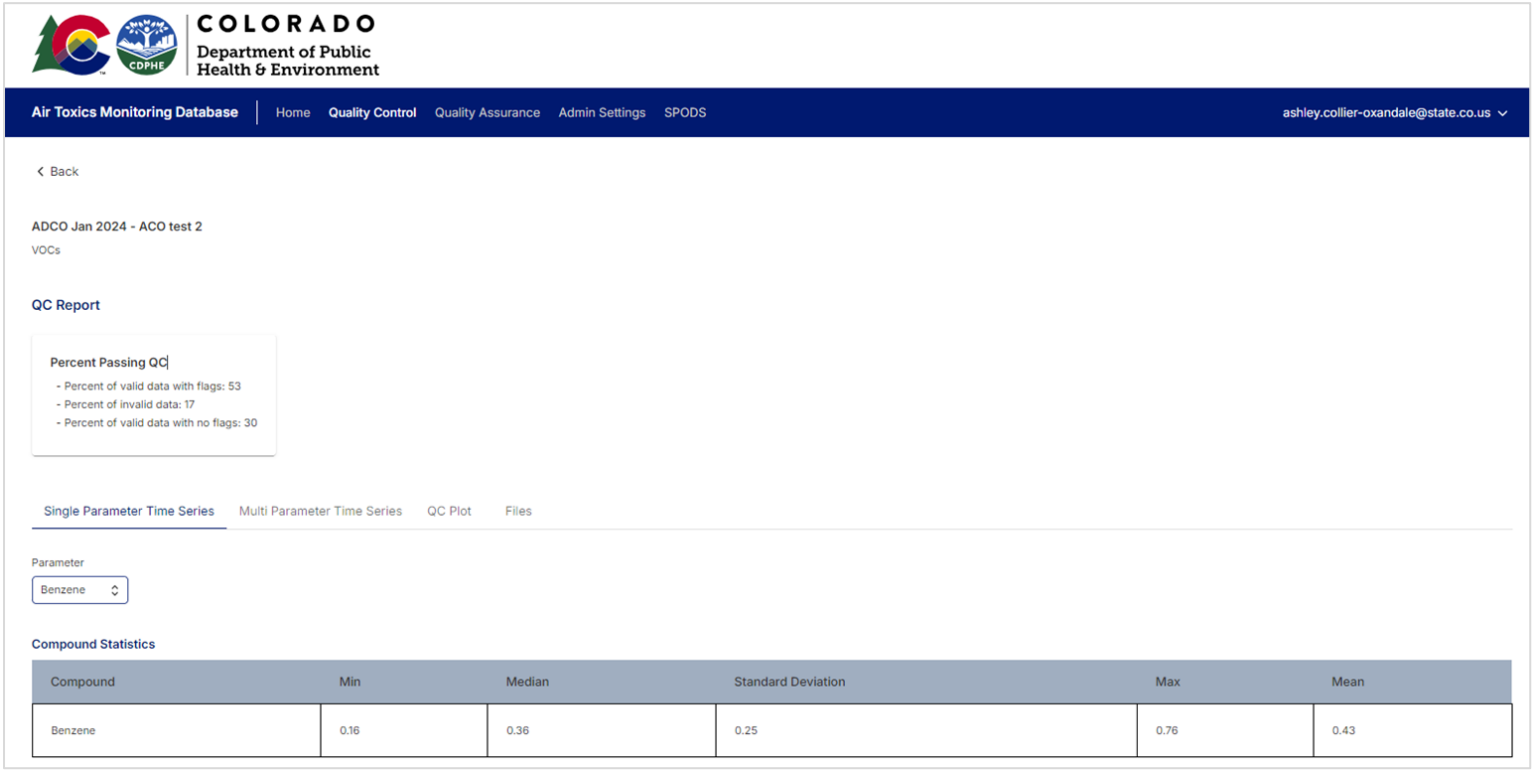
Admin Page: defining and onboarding new monitoring assets, building QA/QC workflows, managing compound and site libraries

ATMD Back-End Details

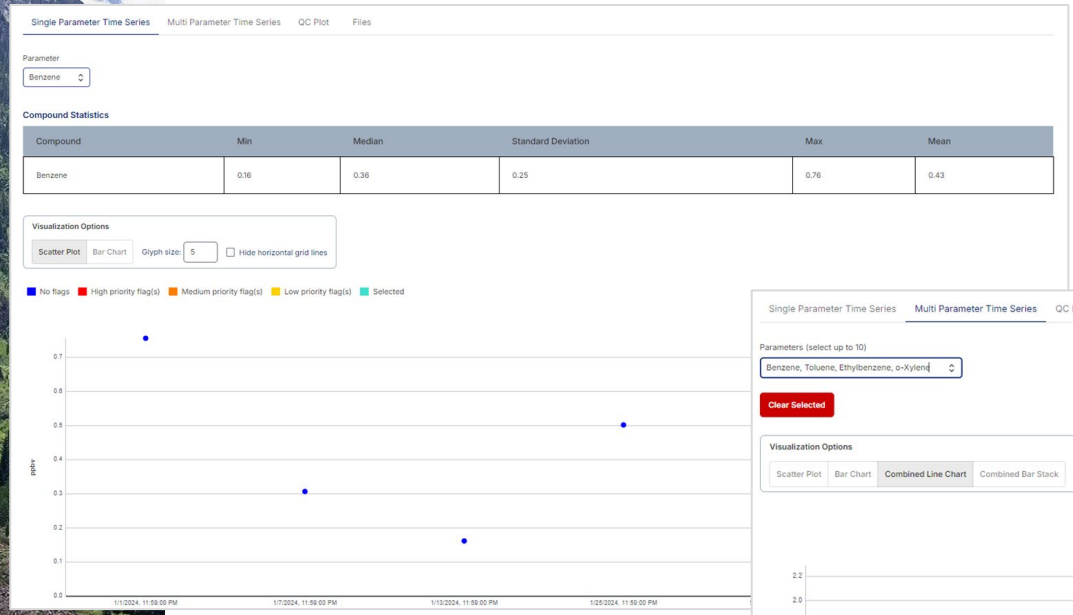
- Using AWS in coordination with other division data modernization efforts
- Saving raw data and QA/QC data separately to “data lake”, and validated data to Redshift database

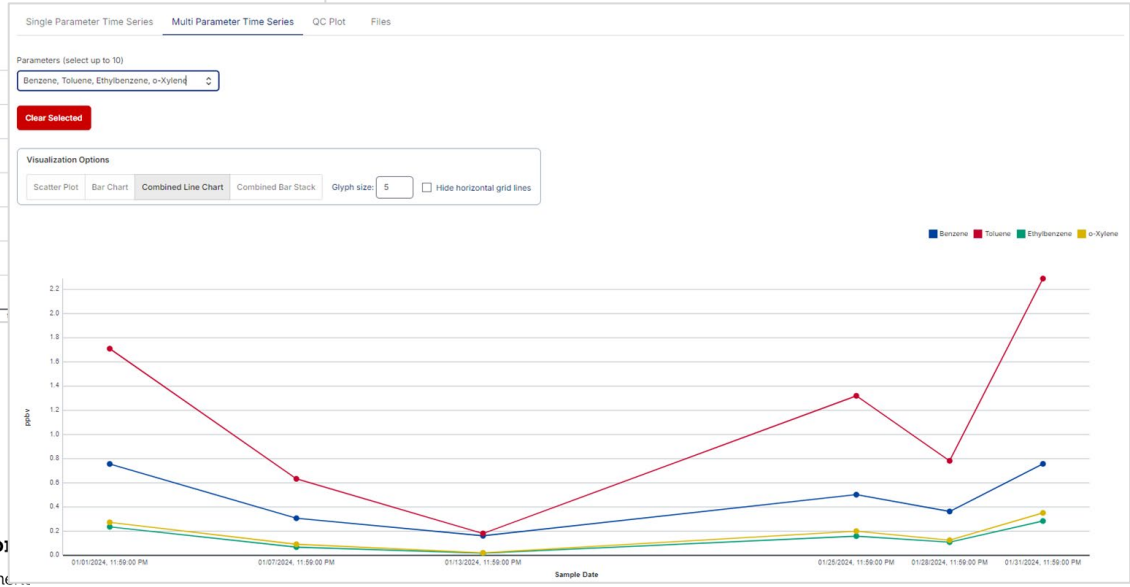


ATMD Web - Application Overview



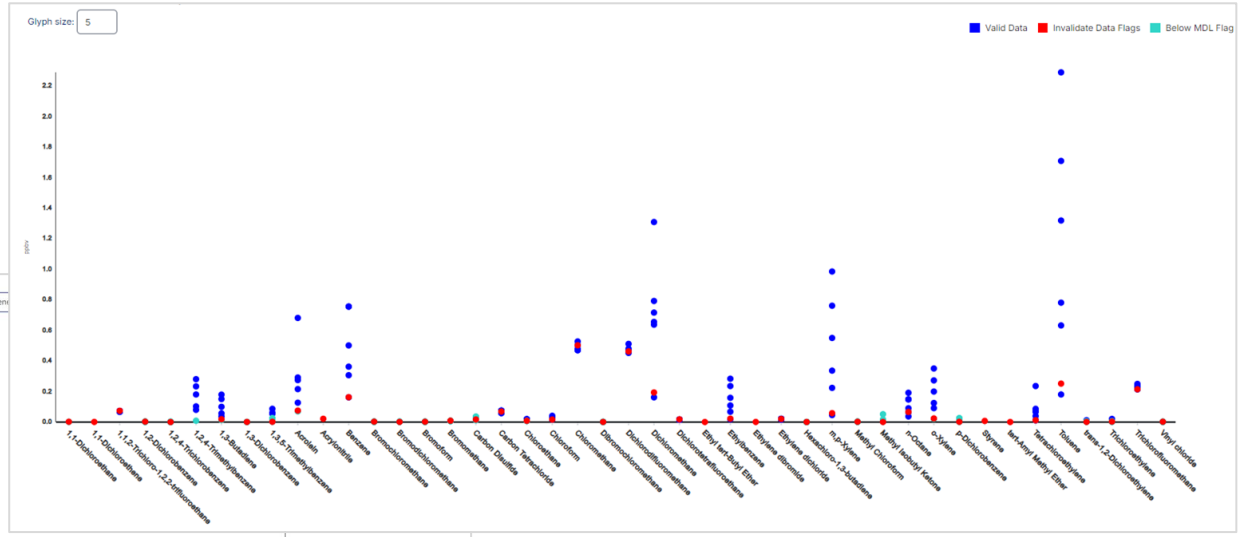
ATMD Web - Application Overview

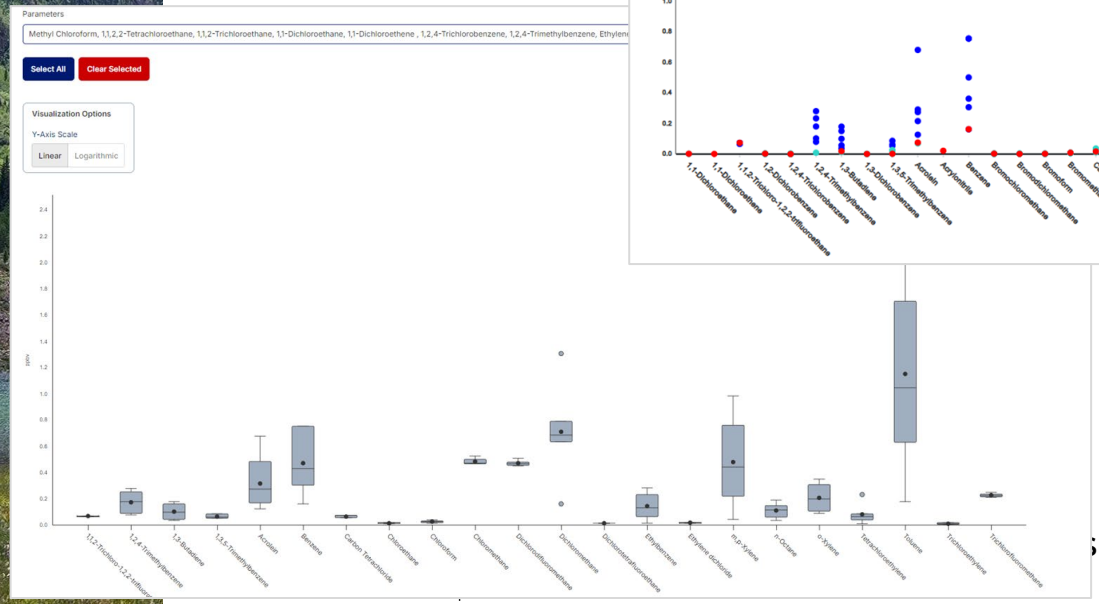




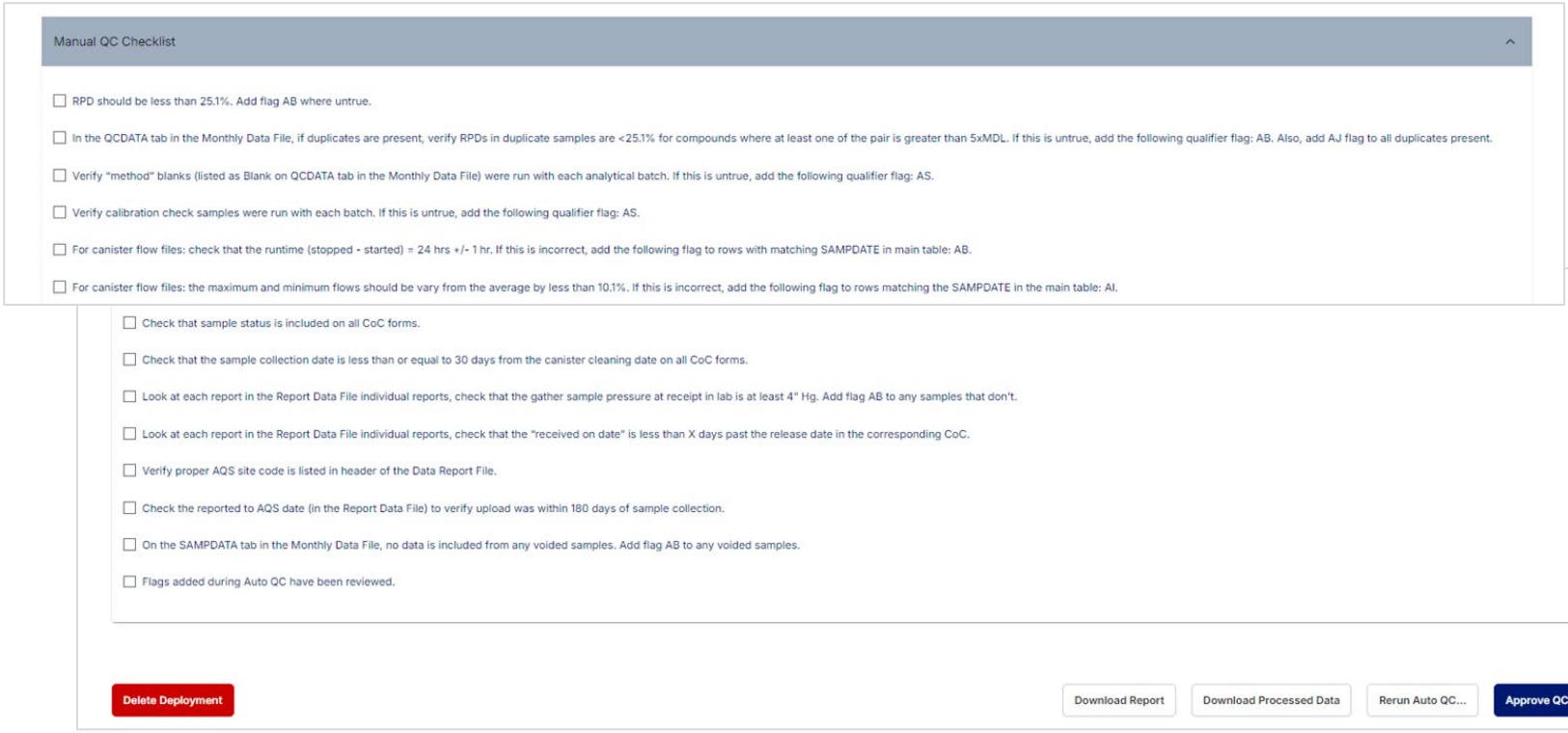
COLORADO
Air Pollution Control Division
Department of Public Health & Environment

ATMD Web - Application Overview





ATMD Web - Application Overview



ATMD Status and Next Steps

Status

- Beta version in rigorous User Acceptance Testing (UAT)

Next Steps

- Complete/build out remaining asset workflows
- Developing QAPPs and audit procedures for data processing
- Begin processing and sharing data using the ATMD

ATMD Challenges and Lessons Learned

- Developing a solution for the broad range and types of data collected by ATOPs Units
  - Time-integrated data - *defined/established workflows*
  - Mobile data - *novel technology with developing workflows*
  - Real-time/streaming data - *ability to track instrument status*
- Developing a flexible and adaptable solution that given that monitoring assets in this program are likely to evolve
- Ensuring solution design conforms to Office of Information Technology requirements

Conclusions

As we continue to build this program and these tools we would love to collaborate and work with others building QA programs for similar instruments

- Advice or feedback on selecting audit criteria for novel instrumentation/compounds?
- Anyone developing QA for similar instrumentation - feedback on process you are using or what you are finding (e.g., accuracy needed for different applications)?
- Is there anyone we should connect with?

North Star: sharing validated air toxics data with the public in meaningful ways

Acknowledgements

I would like to extend a very big THANK YOU to all the team members that contributed to this important work in monitoring air toxics in Colorado!

- CDPHE APCD Division Director: Michael Ogletree
- Complete SAT Team: Alicia Frazier (Supervisor), Anna Cochran, Megan Richie, Timothy Weinmann, and Bryttani West
- Complete MAT Team: Derek Price (Supervisor), Natalie Smith, Ezra Levin (former), Rudra Pokhrel, and Munkhzaya (Mooji) Boldbaatar
- Complete OMM Team: Pamela Rickly (Supervisor), Zachary Finewax, Jon Kinny, Drew Martin, Heather McIntyre, and Riley Kloss

Thank you!

For questions or additional information, please contact:
ashley.collier-oxandale@state.co.us

COLORADO
Air Pollution Control Division
Department of Public Health & Environment