

Modeling, Permitting and Data Needs to Improve Air Quality

Presentation to the Legislative Interim Committee
on Ozone Air Quality
November 8, 2023

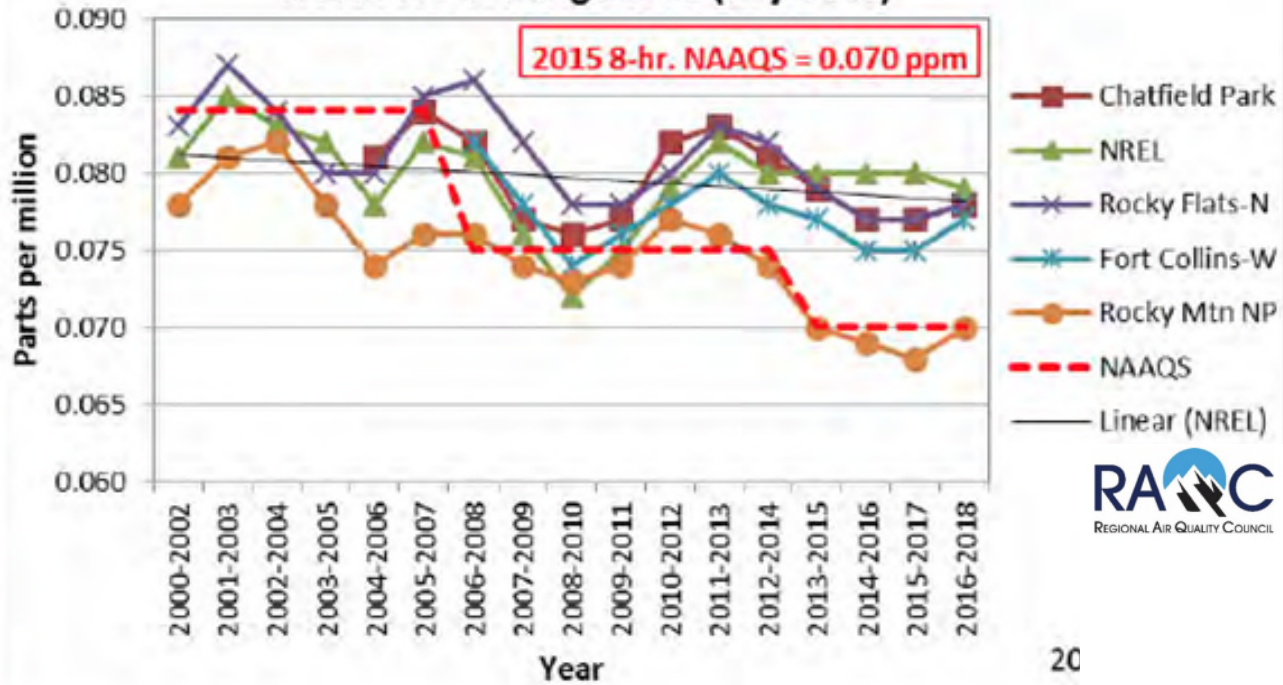
Jana Milford, Ph.D., J.D. Professor Emerita
Department of Mechanical Engineering
University of Colorado Boulder

Biosketch

- Retired Sept. 2022 after 28 years on CU Mechanical and Environmental Engineering faculty
- Research and teaching on air quality modeling, air pollution control, thermal sciences, sustainable energy, and environmental policy
- Colorado Air Quality Control Commission, 1994 – 1997; 2013 – 2022; Regional Air Quality Council 2007 – 2009
- 2023 RACQ/APCD oil and gas inventory collaborative expert review committee
- 2022-23 volunteer consulting with Boulder County and other local governments on legislative proposals, ozone SIP rulemaking, COGCC/ECMC cumulative impacts comments & RAQC control strategy committees
- Presenting today at the invitation of the Legislative Interim Committee. These remarks are my own.

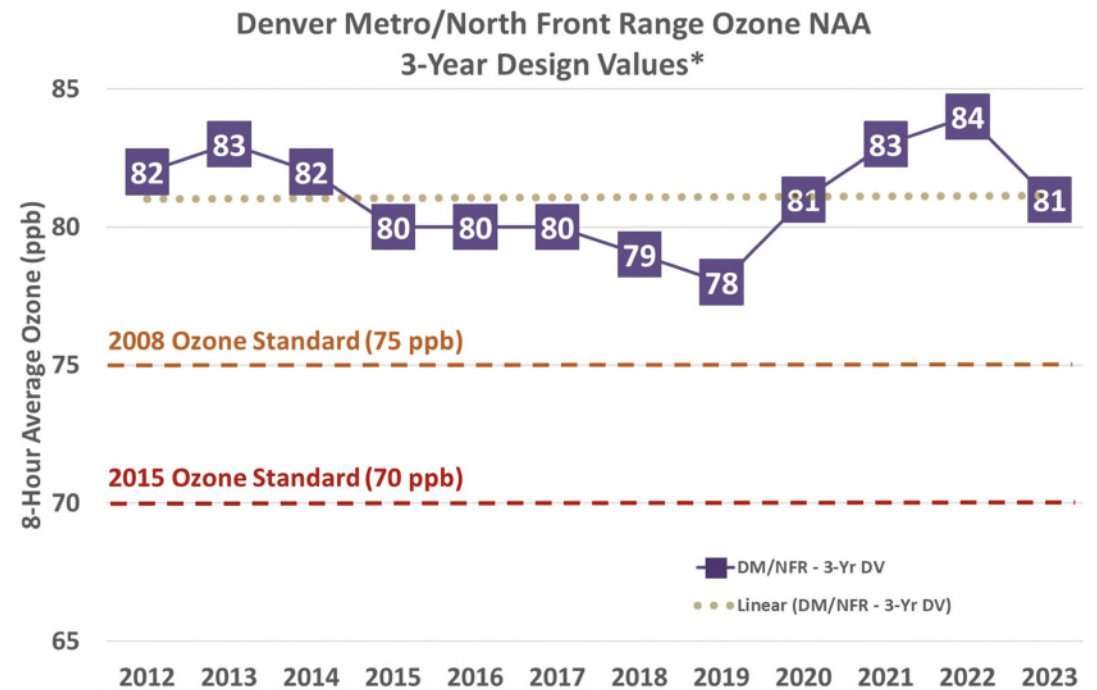
8-Hour Ozone --- 3-year Avg. of 4th Max.

North Front Range area (key sites)



Ongoing challenge of ozone nonattainment

CASAC health experts recommend 55 – 60 ppb 4th maximum 8-hour average as the primary standard (June 2023)



* Data current as of Sept. 13, 2023

Key Points

- Use modeling to understand air quality impacts of new sources or control strategies in advance
- Need to address “temporary” sources – construction, oil and gas pre-production, etc., in minor source permitting and cumulative impacts analysis
 - Temporary sources can contribute to short-term exceedances that in turn contribute to 4th highest daily maximum (O₃) or 98th percentile values for NO₂ and PM_{2.5}
- Opportunities to improve modeling capabilities and application for assessing future scenarios to support precautionary planning

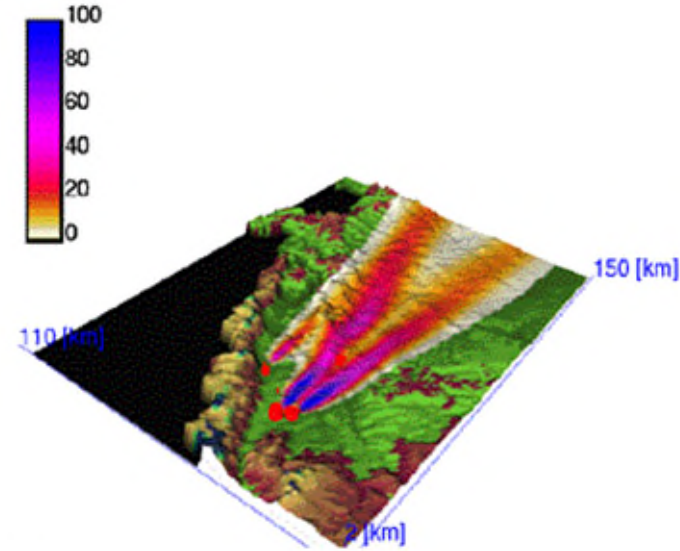
Value of Air Quality Modeling

Can't monitor everywhere, can't monitor in advance, and can't use monitoring to explore options

Models can do all those things

Critical tools for permitting, impact assessment, and planning

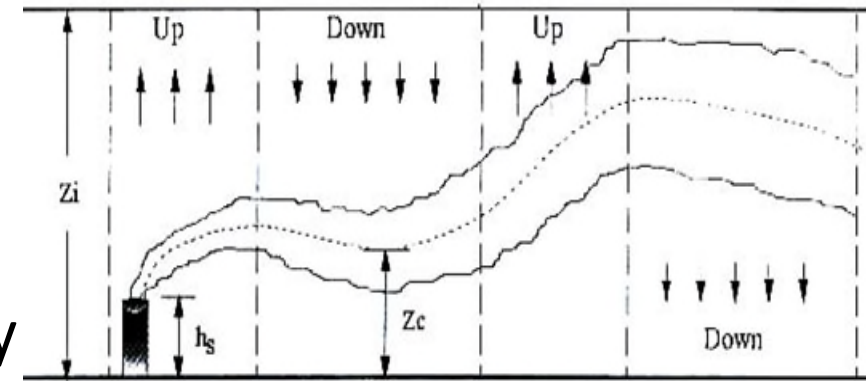
Not just checking a box



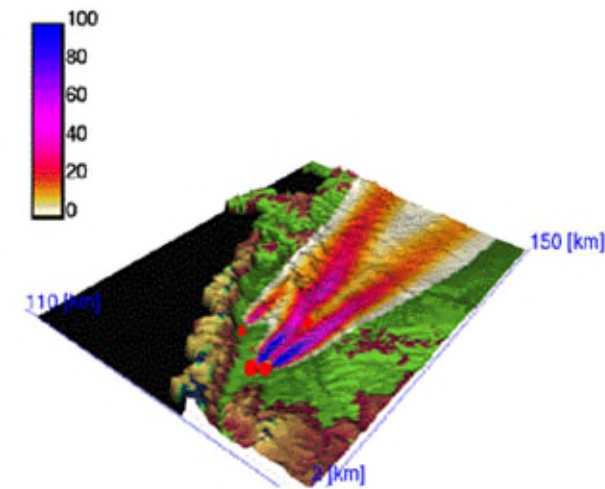
Visualization of air pollution caused by three power stations.

Construction Permit & Cumulative Impact Modeling

- APCD permit issuance requires showing a source "Will not cause or contribute to an exceedance of any National Ambient Air Quality Standards"*
- ECMC required to evaluate potential cumulative impacts
- Needed coverage
 - Primary pollutants
 - Secondary pollutants – streamlined approaches and thresholds
- Needed source definitions
 - Expand to cover "temporary" emissions during critical seasons when they could contribute to exceedances



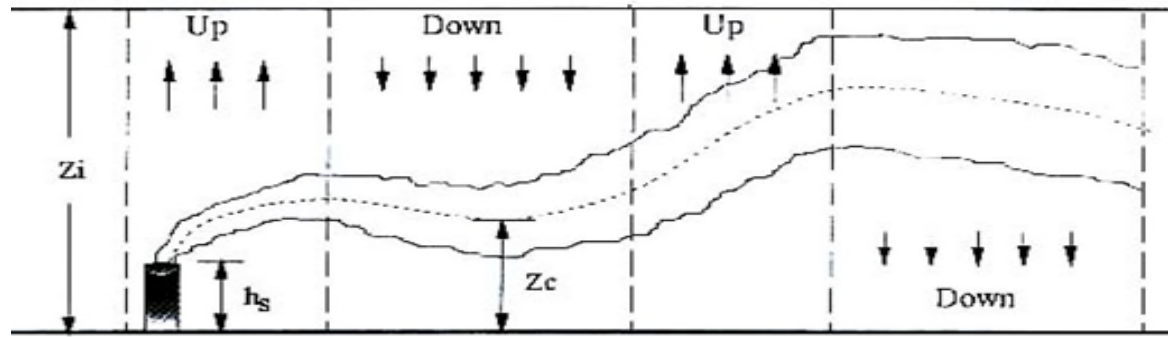
Instantaneous Plume



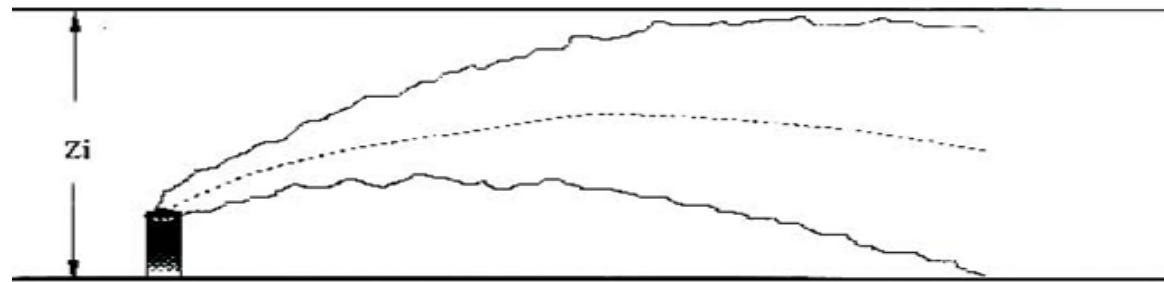
Visualization of air pollution caused by three power stations.

*Regulation 3, Part B, III.D.I.c.

Primary Pollutant Dispersion Modeling



Instantaneous Plume

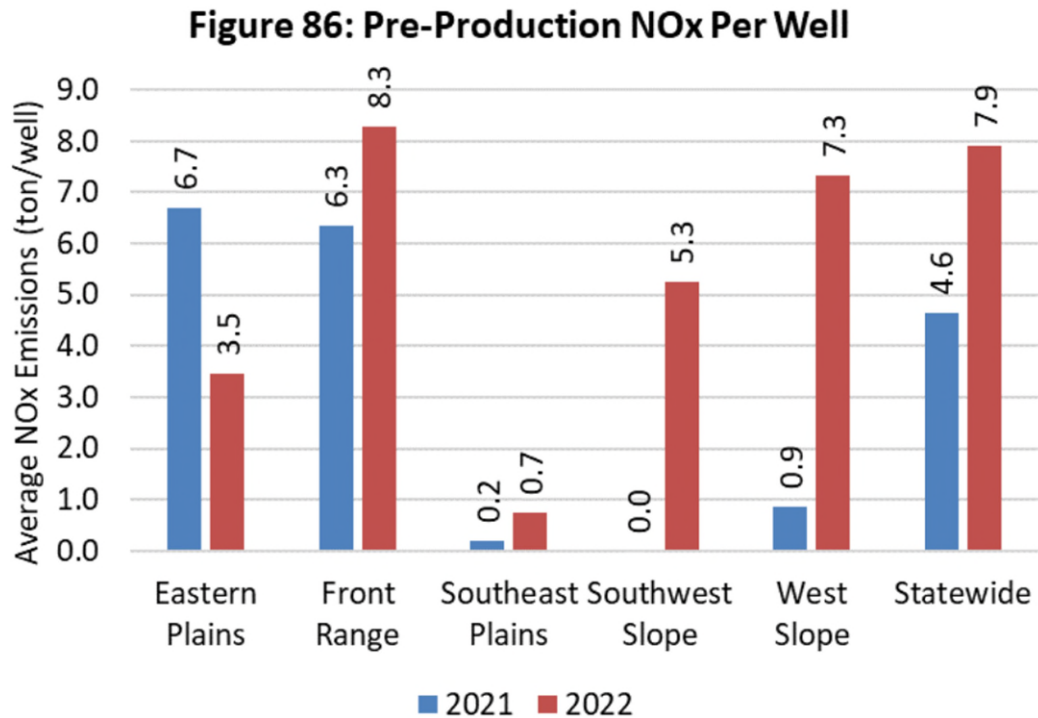


Averaged Plume

- Dispersion Modeling (AERMOD) for NO_2 , SO_2 , PM_{10} , some toxics
- Relatively simple; additive impacts
- Using conservative, pre-set thresholds for modeling is okay, but ...
- Need comprehensive emissions accounting
- Need scientifically sound background levels & meteorology
- Emissions limits must match averaging time for standard

Source Definition

- Consider full pre-production and construction emissions for Colorado modeling during critical seasons



*602 wells approved in Front Range in 2022 at 8.3 tons per well**

602 wells x 8.3 tons/well = 4997 tons NOx in 2022

Drilling & fracking three wells would make a pad a “major” source > 25 tpy if the engines were stationary sources

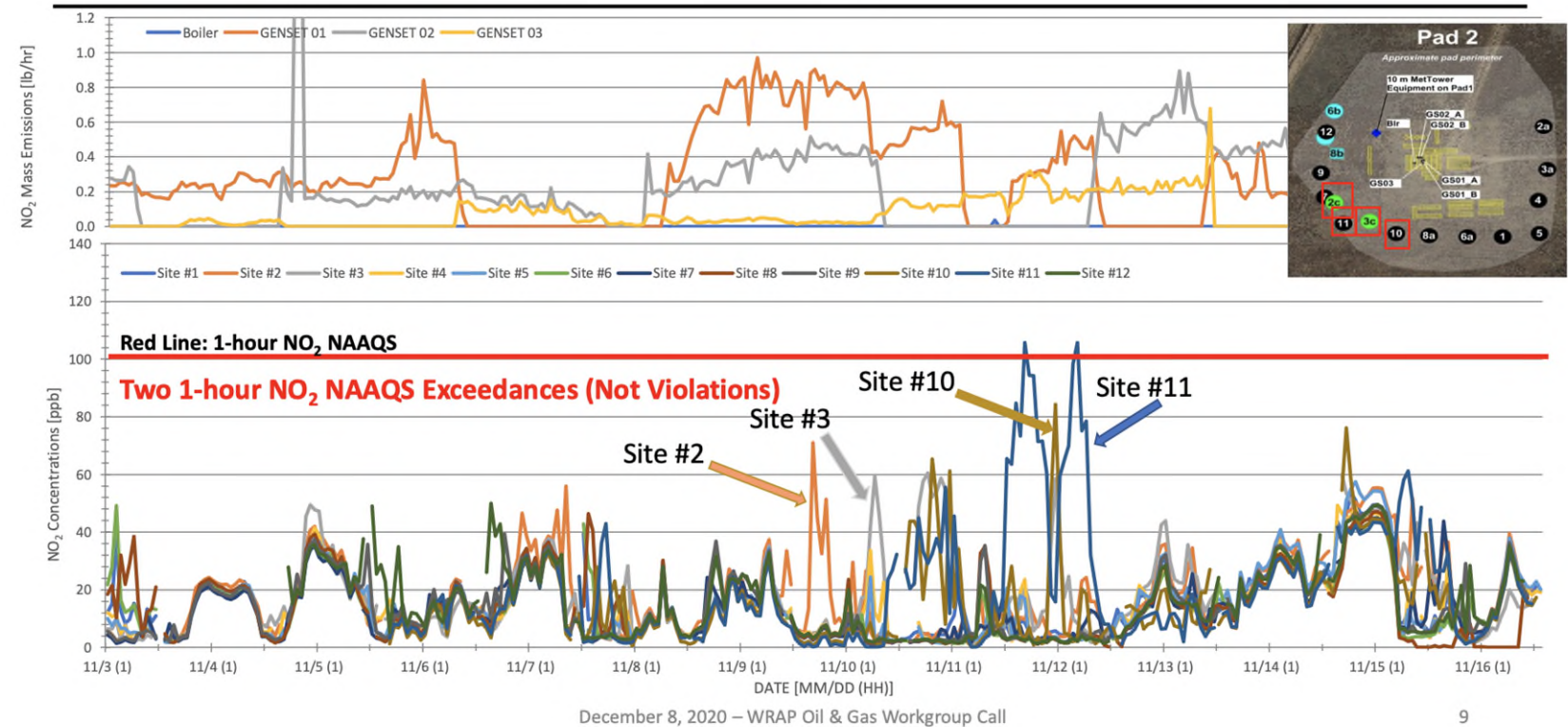
ECMC requires reporting of pre-production emissions, but air quality impacts aren't currently modeled.

*COGCC, February 2023

Source Definition

- 2014 Colorado Oil and Gas Drill Rig Field Study
- Fenceline NO_2 levels near operating drill rigs
- Measurements at two pads near Platteville
- Rigs powered by three Tier 2 engines
- NO_2 standard exceedances at one of the two pads suggest potential for rigs to contribute to high NO_2 exposures

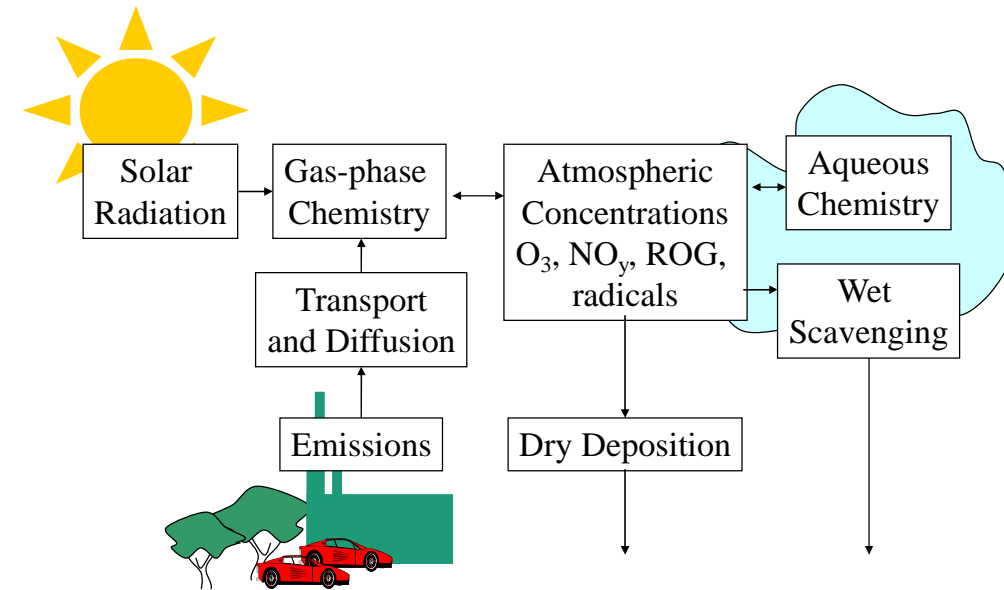
PAD 2: Timeseries of NO_2 Concentrations



Source: 2014 Colorado Oil and Gas Drill Rig Field Study

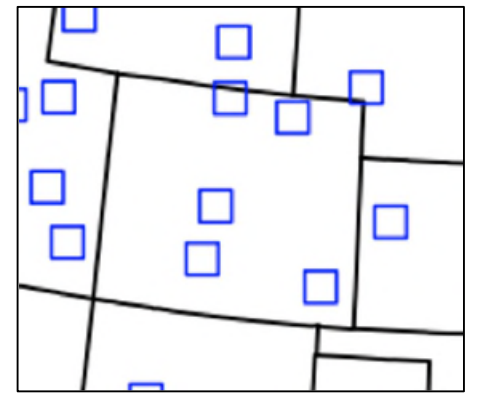
Construction Permit & Cumulative Impact Modeling: Secondary Pollutants

- Ozone, PM2.5, regional haze, nitrogen deposition, some toxics
- Advances in chemistry and transport modeling (CTMs) allow for assessing impacts of individual sources on secondary pollution (EPA, 2019)
- EPA 2019 guidance for rural attainment areas offers a good conceptual approach for streamlining modeling, but it needs to be adapted to suit Colorado's nonattainment area



Single Source Secondary Pollutant Modeling

- EPA two-tier approach (EPA, 2022)
 - Tier 1 – fixed relationships (sensitivity coefficients) between emissions and air quality impacts, pre-determined using chemistry and transport modeling for representative single source perturbation
 - Tier 2 – direct application of CTM to assess impacts of new source
- EPA guidance on modeling thresholds
 - For sources in attainment areas, require analysis for ambient air quality impacts if emissions are greater than significant emissions rates (SER) thresholds of 40 tpy VOC, NO_x, SO₂, or NH₃ or 10 tpy PM_{2.5}
 - Address impacts/required cumulative analysis if greater than “significant impact level”
- APCD’s current modeling threshold of 200 tpy NO_x* is too high for Colorado
 - Corresponds to up to a 0.85 ppb ozone impact using EPA’s circa 2011 sensitivity coefficients
 - Permit authority has discretion to use lower Significant Impact Levels or set lower threshold for modeling



EPA (2019) hypothetical PSD source modeling locations for CO

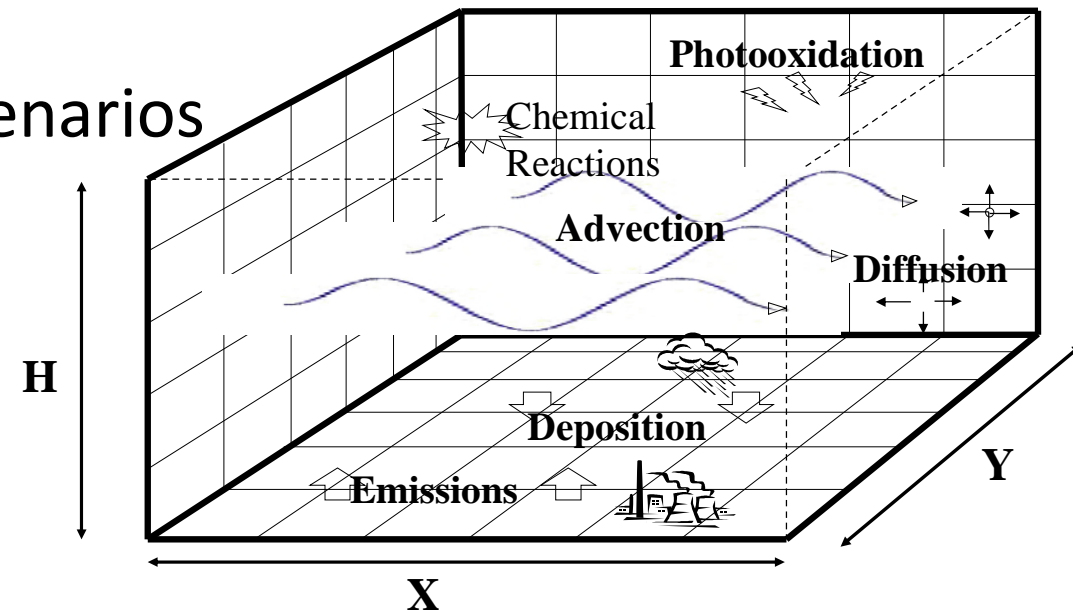
*APCD, September 2023 Presentation to Legislative Interim Committee

Secondary Pollutants Recommendation

- Use Colorado's updated SIP modeling platform to develop customized Tier 1 sensitivity coefficients & apply to sources exceeding SER thresholds.
- Use Tier 2 approach with direct modeling for larger sources.
- Establish lower significant impact level & corresponding mitigation requirements that are appropriate for the nonattainment area
- Apply to any emissions (including temporary emissions in ozone season) that will not be offset
- Sensitivity coefficients (maximum ozone change per ton of NO_x or VOC emissions in a particular county) can be determined in advance by APCD chemistry and transport modeling, then applied by source as a simple factor from a look-up table

Regional Modeling for State Implementation Planning

- Colorado has used a generally sound chemistry and transport platform for modeling history
- Current system is challenged with respect to future projections and control strategy analysis
- Platform needs updating (underway)
- Need improved emissions inventories
- Need more consideration of different scenarios
 - Future emissions trends
 - Future meteorology



Emissions Inventory Needs

- Greater transparency about underlying assumptions*
- Ability to explicitly connect on-the-books regulations and prospective control strategies to inventory estimates*
- Ability to readily link operator emissions reports to inventory*
- Up-to-date data on critical equipment and activity factors
 - Lawn and Garden Equipment (outdated national defaults)
 - Oil and gas (outdated & incomplete operator survey)
- Future projections
 - Last SIP included simplified, subjective projections that lagged actual trends*
 - Need multiple scenario-based projections with regular updates

* Similar to findings from RAQC/APCD collaborative review committee

Recommendations

- Expanded construction permit & cumulative impact assessment requirements
 - Used streamlined approach to model impacts on secondary pollutants at lower emissions threshold
 - Fully account for ongoing “temporary” emissions including pre-production activities and extended construction projects
 - Require modeling or reductions as needed to show *in advance* that source will not cause or contribute to any exceedance, including ozone, NO₂ and PM_{2.5}
- Provide support for APCD, RAQC and ECMC to enhance their regional modeling system
 - Information collection to adequately update emissions inventories & control strategy development
 - Scenario-based projections that can inform mid-course corrections & contingency planning
 - Sensitivity analysis tools for source contribution analysis to support permitting and cumulative impact analysis needs.

References

- APCD, Air Quality and Permit Modeling in 2023, Presentation to the Legislative Interim Committee on Ozone Air Quality, September 22, 2023
- Colorado Field Study Workgroup, 2014 Colorado Oil and Gas Drill Rig Field Study, presentation at the WRAP Oil and Gas Workgoup Call, Dec. 8, 2020 (https://www.wrapair2.org/pdf/WRAP_OG_WG_Overview_Colorado_NO2_Drill_Rig_Study_12082020.pdf)
- COGCC, Report on the Evaluation of Cumulative Impacts, Rule 904.a, February 2023
- U.S. EPA (2019). *Guidance on the Development of Modeled Emission Rates for Precursors (MERPS) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program*. (EPA-454/R-19-003). Research Triangle Park, NC
- U.S. EPA Guidance for Ozone and Fine Particulate Matter Permit Modeling, EPA-454/R-22-005, July 2022