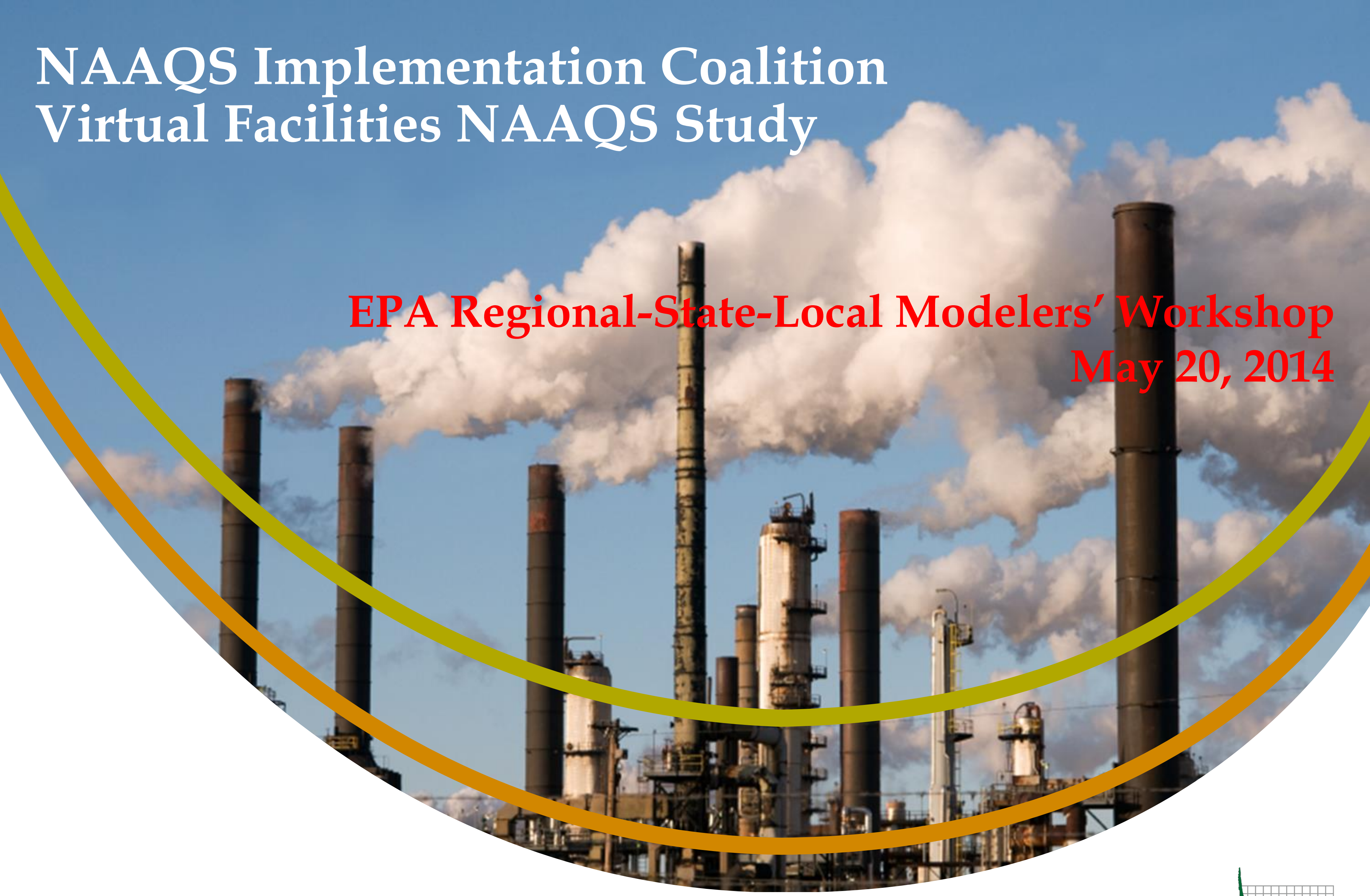
NAAQS Implementation Coalition
Virtual Facilities NAAQS Study



EPA Regional-State-Local Modelers' Workshop
May 20, 2014

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Objectives

- Demonstrate challenges modeling compliance with applicable NAAQS using current EPA modeling techniques and guidance
  - Clarification memoranda and piecemeal guidance
  - Ubiquitous challenges for various facility types
  - Challenges independent of geography and climate
- Identify key technical and policy issues to focus attention in 2014 leading up to 11th Modeling Conference in March 2015
  - Non-default model options
  - Allowable emissions
  - Background concentrations
  - Ambient air

Approach and Guidance

- Utilize current* regulatory modeling techniques and default, commonly accepted approaches following EPA guidance
  - *Guideline on Air Quality Models* – 40 CFR Part 51, Appendix W, Revised November 9, 2005
  - "AERMOD Implementation Guide," Revised March 19, 2009
  - "Modeling Procedures for Demonstrating Compliance with PM2.5 NAAQS," March 23, 2010
  - "Applicability of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS," June 28, 2010
  - "Applicability of Appendix W Modeling Guidance for the 1-hour SO2 NAAQS," August 23, 2010
  - "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS," March 1, 2011
  - "Draft Guidance for PM2.5 Modeling," March 4, 2013
  - "Use of AERMOD Meteorological Data in AERMOD Dispersion Modeling," March 8, 2013
  - "AQMG / Model Clearinghouse statement concerning the AERMET/AERMOD (version 12345) BETA options," June 26, 2013

- Do *not* utilize highly refined techniques that would require case-by-case approval or exceedingly specific permit limitations
- Simulate typical, not extreme analysis

* **AERMOD/AERMET 13350 and March 2013 PM2.5 permit modeling guidance for primary PM2.5 impacts only**

Representative Facility Design

- Design three hypothetical facilities
  - Generalized to remove any identifying characteristics
  - Representative of larger class of operations by emission rates and stack parameters
  - Simulate typical, average size, well-controlled operations

  1. Gas-fired EGU
  2. Gas-fire Refinery (generally representative of petrochemicals)
  3. Industrial manufacturing (generally representative of a wide variety of facilities including, consumer products and commodity manufacturing, facilities with significant bulk raw material handling, and a variety of processing operations)
- Select three locations to examine impacts of climate, geography, ambient background
  1. **North Carolina (rolling to complex terrain)**
  2. Louisiana (flat terrain)
  3. Montana (valley with surrounding complex terrain)
- ***The study authors and sponsors are not aware of any plans to actually propose or construct the hypothetical facilities or other facilities in the areas evaluated in this study***

PM2.5 – 24-hour Average

- 24-hour average PM2.5 impacts driven by manufacturing operations
- Fugitive emissions (roads, piles, transfers) particularly culpable
- Gas-fired operations have relatively low impact
- Geographic extent of high impacts limited because of concentration gradient due to low level sources

Value	Impact	Description
NAAQS	**35.0**	24-hr PM2.5 NAAQS evaluated as multi-year average of 98th percentile
ALL	**65.99354**	**Cumulative impact with 24-hr average background**
BACKGROUND	21.6	21.6 is the EPA-reported 3-year average 24-hr design value
BACKGROUND	20.2	Based on Tier 2 Seasonal Analysis
BACKGROUND	11.1	Based on Hourly Pairing
ALLNOBKG	44.39354	Cumulative impacts without background
MCP ONLY	**65.53163**	**As if MCP were the only facility, includes default background concentration**
MCP	43.93163	MCP contribution to overall impact
EGU ONLY	**29.70365**	**As if EGU were the only facility, includes default background concentration**
EGU	8.10365	EGU contribution to overall impact
REFINERY ONLY	**26.91607**	**As if Refinery were the only facility, includes default background concentration**
REFINERY	5.31607	Refinery contribution to overall impact

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

PM2.5 - 24-hour Background Concentrations

- 24-hour background concentrations significant
  - Alternative Tier 2 seasonal formulation lowers background, but not as much as it could or Paired Sums would

Western U.S.

98th Percentile DV	2010	2011	2012	3-year Average DV
Annual	26.1	26.7	18.8	23.9
Spring	10.8	12.9	13.9	12.5
Summer	11.4	16.1	14.7	14.1
Fall	21.7	25.3	15.1	20.7
Winter	26.1	26.7	18.8	23.9

Outcome potentially varies significantly (or not at all), but only if model independently computes DV during "low PM2.5 season"

Southeastern U.S.

98th Percentile DV	2010	2011	2012	3-year Average DV
Annual	21.5	26.4	16.9	21.6
Spring	19.1	18.1	13.7	17.0
Summer	19.0	26.4	15.1	20.2
Fall	20.0	12.2	15.2	15.8
Winter	21.5	17.2	16.9	18.5

Less seasonal variability, each seasonal DV is lower than annual DV

All concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

PM2.5 – Annual Average

- Annual average PM2.5 impacts driven by manufacturing operations
- Fugitive emissions (roads, piles, transfers) particularly culpable
- Gas-fired operations have relatively low impact

Value	WORST CASE	Description
NAAQS	**12.0**	Annual PM2.5 NAAQS evaluated as multi-year average of 98th percentile
ALL	**29.00260**	**Cumulative impact with Annual average background**
BACKGROUND	10.1	10.1 is the EPA-reported 3-year average Annual design value
ALLNOBKG	18.90260	Cumulative impacts without background
MCP ONLY	**28.72483**	**As if MCP were the only facility, includes default background concentration**
MCP	18.62483	MCP contribution to overall impact
EGU ONLY	**11.16500**	**As if EGU were the only facility, includes default background concentration**
EGU	1.06500	EGU contribution to overall impact
REFINERY ONLY	**10.98366**	**As if Refinery were the only facility, includes default background concentration**
REFINERY	0.88366	Refinery contribution to overall impact

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

PM2.5 – Fugitive Emissions and Low Winds Speeds

- Roads, low-level fugitive emissions contribute most to impact; most vulnerable to wind speed effects
- Common differences among low wind speed options regardless of location
  - 24-hour average – fugitive emissions (roads)

M_ROADS	Default	LOWWIND1 (ADJ_U*)	LOWWIND2 (ADJ_U*)
North Carolina	18.54071	12.55753	8.77370
Montana	17.15249	19.02071	16.54018
Louisiana	28.80632	23.45040	14.89210

  - Annual average – cumulative impacts

ALL	Default	LOWWIND1 (ADJ_U*)	LOWWIND2 (ADJ_U*)
North Carolina	18.90260	17.85592	18.03641
Montana	25.39378	22.40102	21.92553
Louisiana	10.41966	9.29031	9.08751

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

1-hour NO_2

- Combustion sources contribute to high modeled impacts
  - Emergency RICE particularly significant – even if limited to single hour per day to represent transient operation
- Background concentrations could make a significant difference if applied seasonal/hourly

Value	**TIER 2**	**Description**
NAAQS	**188.1**	1-hour NO_2 NAAQS evaluated as multi-year average of 98th percentile
ALL	867.53588	**Cumulative impact with seasonal/hourly background**
BACKGROUND	46.50200	Computed seasonal/hourly background associated with modeled design value
BACKGROUND	79.01840	3-year average 98th percentile design value
ALLNOBKG	821.03388	Cumulative impacts without background
MCP ONLY	**900.00734**	**As if MCP were the only facility, includes default background concentration**
MCP	820.98894	As if MCP were the only facility
EGU ONLY	**220.05382**	**As if EGU were the only facility, includes default background concentration**
EGU	141.03542	As if EGU were the only facility
REFINERY ONLY	**808.44293**	**As if Refinery were the only facility, includes default background concentration**
REFINERY	729.42453	As if Refinery were the only facility

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

1-hour NO2 – Refined Methods

- Higher Tier (ARM2/OLM/PVMRM) options important at all locations
  - Need streamlined acceptance
    - Ozone data sets
    - NO2/NOX ISR

Model Tier	North Carolina	Montana	Louisiana
Tier 1	1110.99	1446.15	1012.00
Tier 2 ARM	867.54	1156.92	809.60
Tier 2 ARM2	205.26	289.23	202.40
Tier 3 PVMRM	605.80	858.97	510.31
Tier 3 OLM	573.69	786.43	496.53

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

1-hour SO2

- 1-hour average SO2 impacts driven by higher sulfur fuel combustion

Value	WORST CASE	Description
NAAQS	**196.3**	1-hour SO2 NAAQS evaluated as multi-year average of 99th percentile
ALL	**196.93099**	**Cumulative impact with seasonal/hourly background**
BACKGROUND	36.64622	3-year average 99th percentile design value
ALLNOBKG	187.68633	Cumulative impacts without background
MCP ONLY	**224.30797**	**As if MCP were the only facility, includes default background concentration**
MCP	187.66175	As if MCP were the only facility
EGU ONLY	**39.75865**	**As if EGU were the only facility, includes default background concentration**
EGU	3.11243	As if EGU were the only facility
REFINERY ONLY	**116.78166**	**As if Refinery were the only facility, includes default background concentration**
REFINERY	80.13544	As if Refinery were the only facility

All modeled concentrations reported in micrograms per cubic meter ($\mu g/m^3$)

- Seasonal/hourly background concentrations could make a significant difference (11.3 $\mu g/m^3$ at modeled design value compared to 36.6 $\mu g/m^3$)

Summary

- PM2.5
  - Fugitive, especially low-level, primary PM2.5 sources particularly challenging
  - LOWWIND option and ambient air determination significant
  - Background concentrations challenges
  - Need to consider impacts of final permit modeling guidance with regard to adding secondary PM2.5
- NO2
  - Combustion sources likely to continue seeking improvement and streamlined approval for Tier 3 methods
- SO2
  - Higher sulfur fuel combustion is challenging – especially for backup/SSM – when variability is not accounted

Questions?

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