Civil & Environmental Consultants, Inc.

$PM_{2.5}$ and Ozone Permitting and Modeling in the Age of MERPs

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Midwest A&WMA's 27th Annual Technical Conference

Lenexa, KS

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Agenda

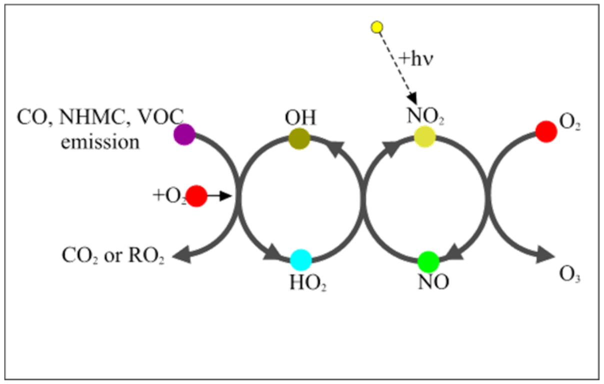
- About $PM_{2.5}$ and Ozone
- MERPs guidance overview
- Other $PM_{2.5}$ and Ozone guidance
- Case Study: Using MERPs in a permit application
- Summary and Outlook

$PM_{2.5}$ and Ozone Formation

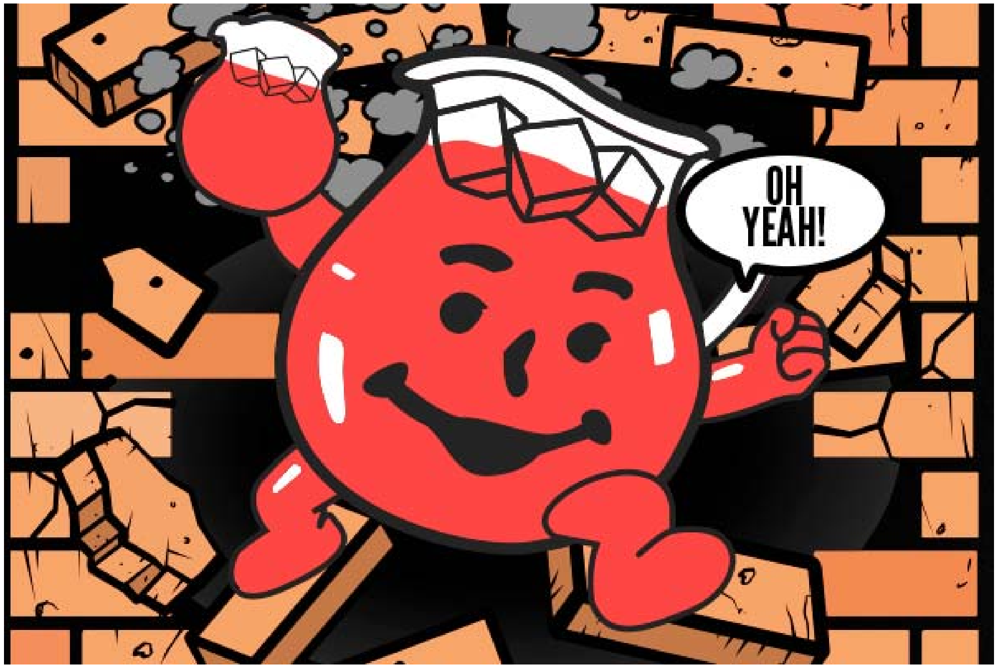
- $PM_{2.5}$ = Particulates with diameters ≤ 2.5 µm
  - Emitted directly (primary) or formed in the atmosphere (secondary)
  - Sulfate, nitrate, ammonium, organic carbon, elemental carbon, crustal elements, sea spray constituents, and oxidized metals
- Ozone = O_3, good in the stratosphere, not in the troposphere!
- Secondary $PM_{2.5}$ and Ozone are formed in the atmosphere via complex photochemical reactions
  - Warm, sunny days => More formation
  - “Ozone Season”
- Precursors are emitted by sources:
  - Ozone: VOC and NO_X
  - $PM_{2.5}$: SO_2 and NO_X

$PM_{2.5}$ and Ozone Formation

- How to quantify secondary $PM_{2.5}$ and Ozone?
  - Atmospheric conditions (temperature, solar radiation, wind speeds, humidity)
  - Ambient concentrations
    - Ozone: NO_x, VOC
    - $PM_{2.5}$: SO2, NOX, Ammonia (NH3)
- Photochemical Grid models: CAMx, CMAQ
  - Highly complex, typically used for regional-scale modeling and SIP evaluations
  - Generally impractical for single-source permitting
- But secondary formation has to be evaluated for permits…



Enter MERPs



What is a MERP?

- **M**odeled **E**mission **R**ates for **P**recursors
  - Represent the emission rate of a precursor that (by itself) will not exceed the relevant Significant Impact Level (SIL)
- Developed by EPA as a "Tier 1" demonstration tool to evaluate secondary impacts of $PM_{2.5}$ and Ozone
- Based on photochemical grid modeling completed by EPA
- Basic MERP equation:
  - $MERP[tpy] = SIL\left[ppb\ or\ \frac{\mu g}{m^3}\right] \times \frac{Precursor\ Emission\ Rate\ [tpy]}{Air\ Quality\ Impact\ \left[ppb\ or \frac{\mu g}{m^3}\right]}$
- MERPs for each precursor and each standard

CEC

Precursors and Standards with MERPs

	$PM_{2.5}$ 24-hr	$PM_{2.5}$ Annual	Ozone 8-hr
SO_2	✓	✓	
NO_2	✓	✓	✓
VOC			✓

MERPs Guidance

- EPA released final April 30, 2019
- Guidance includes
  - Information about $PM_{2.5}$ and Ozone formation
  - Results and descriptions of EPA's modeling
  - Information for developing additional MERPs
  - Example permitting evaluations using MERPs
  - Excel file of modeled sources and results

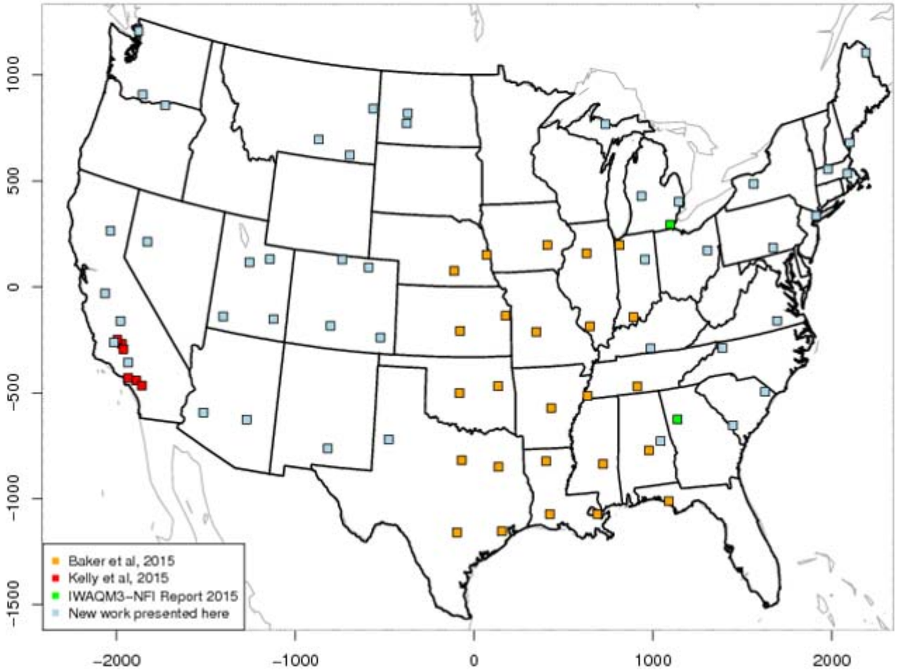
- Available on the SRAM Permit Modeling Guidance page:
  - https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance

Hypothetical Sources

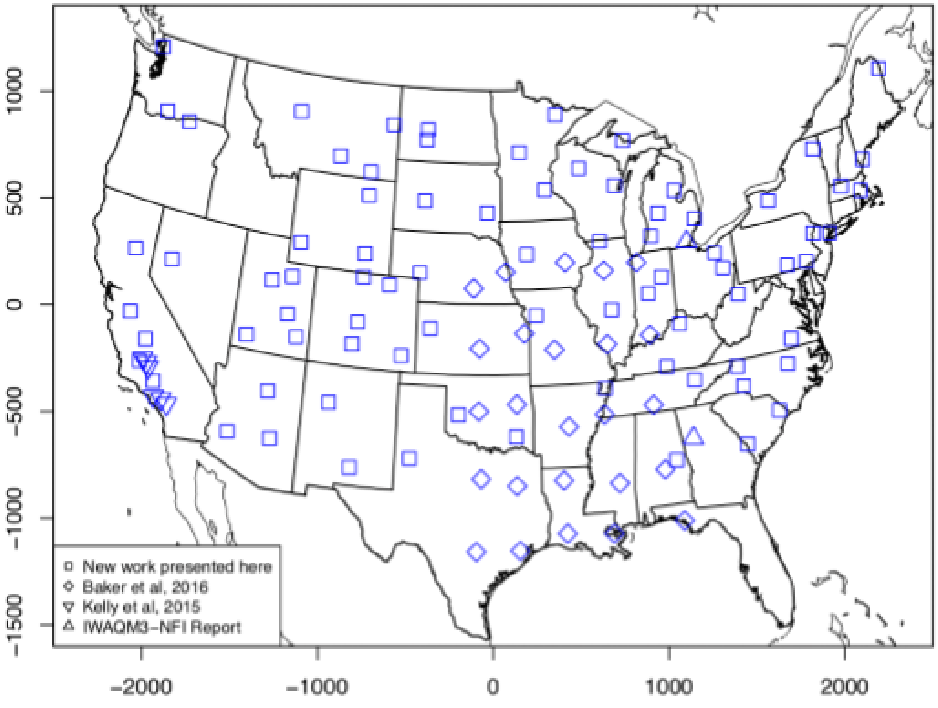
- Generic point sources used for EPA's photochemical modeling
- Point source parameters:
  - Diameter: 5 m (16.4 ft)
  - Temperature: 311 K (100 °F)
  - Velocity: 27 m/s (89 ft/s)
- Two Release Heights:
  - Low: 10 m (33 ft)
  - High: 90 m (295 ft)
- Three Precursor emission rates: 500, 1000, or 3000 tpy
- Modeled impacts for each precursor, pollutant, and standard at each release height and emission rate

Hypothetical Sources

Dec 2016 Draft

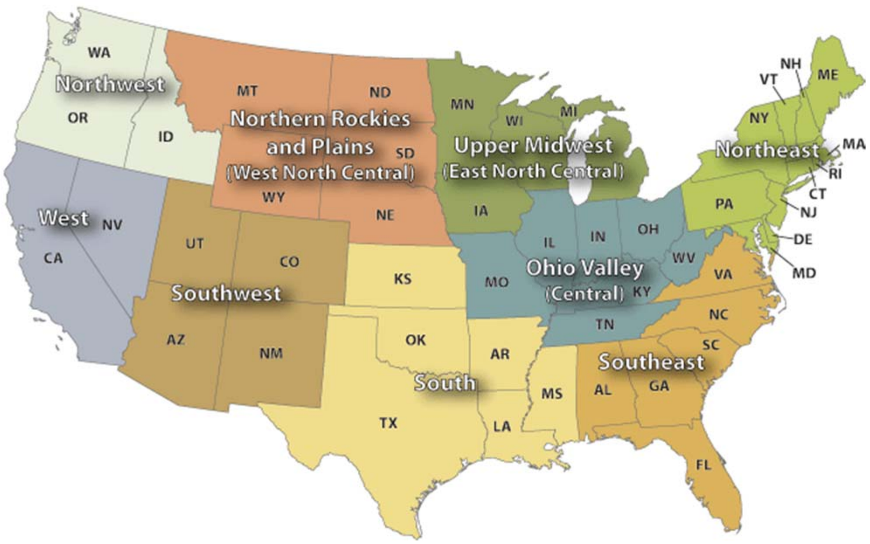


Apr 2019 Final



Climate Zones

- Hypothetical sources subdivided by NOAA Climate Zone

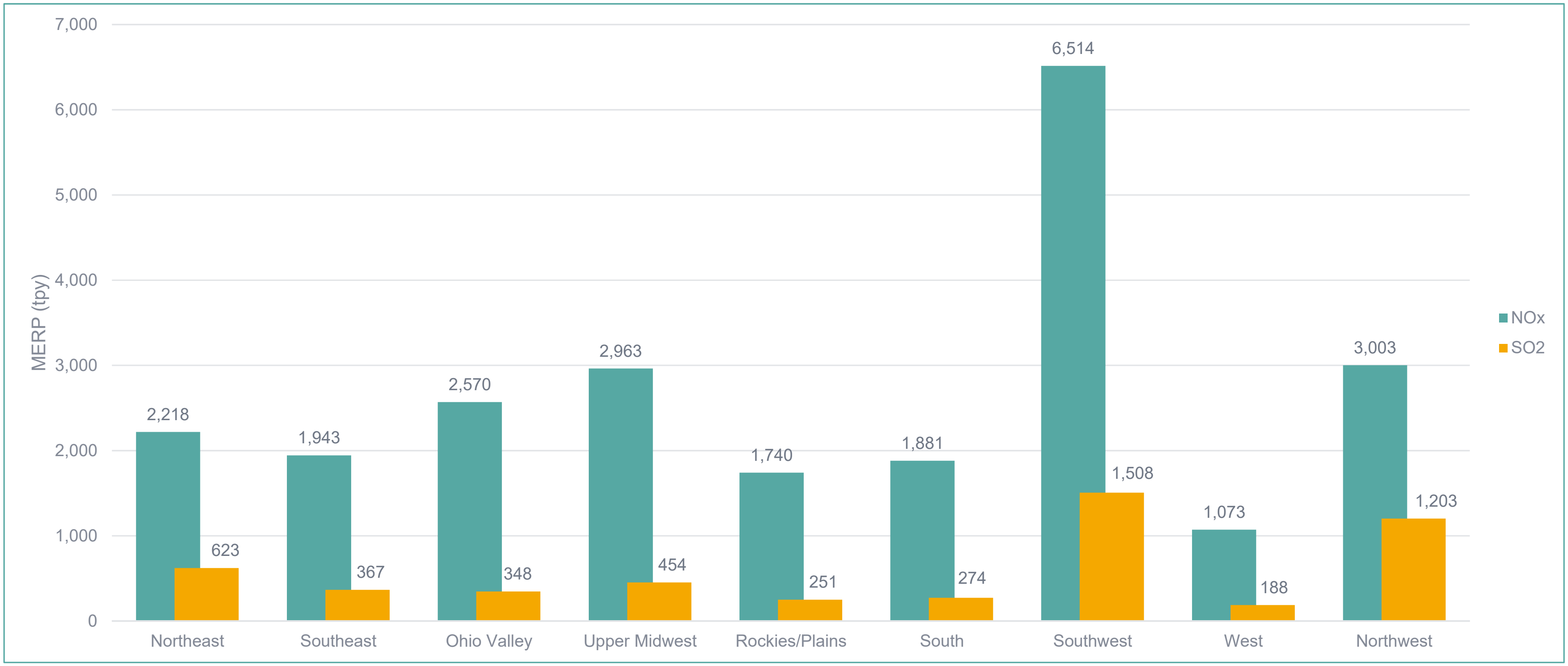


Climate Zone	Sources
Northeast	10
Southeast	9
Ohio Vally	19
Upper Midwest	12
Rockies/Plains	14
South	17
Southwest	15
West	6
Northwest	3

MERPs Guidance

- Final guidance expanded info about hypothetical sources
  - Maximum terrain height within 50 km
  - Fractional Urban coverage within 50 km
  - Lat/Long coordinates
- Example scenarios for use of MERPs
  - PSD Significant Impact
  - Cumulative Analysis
  - Class I Analysis

Regional MERPs – PM2.5 24-hr



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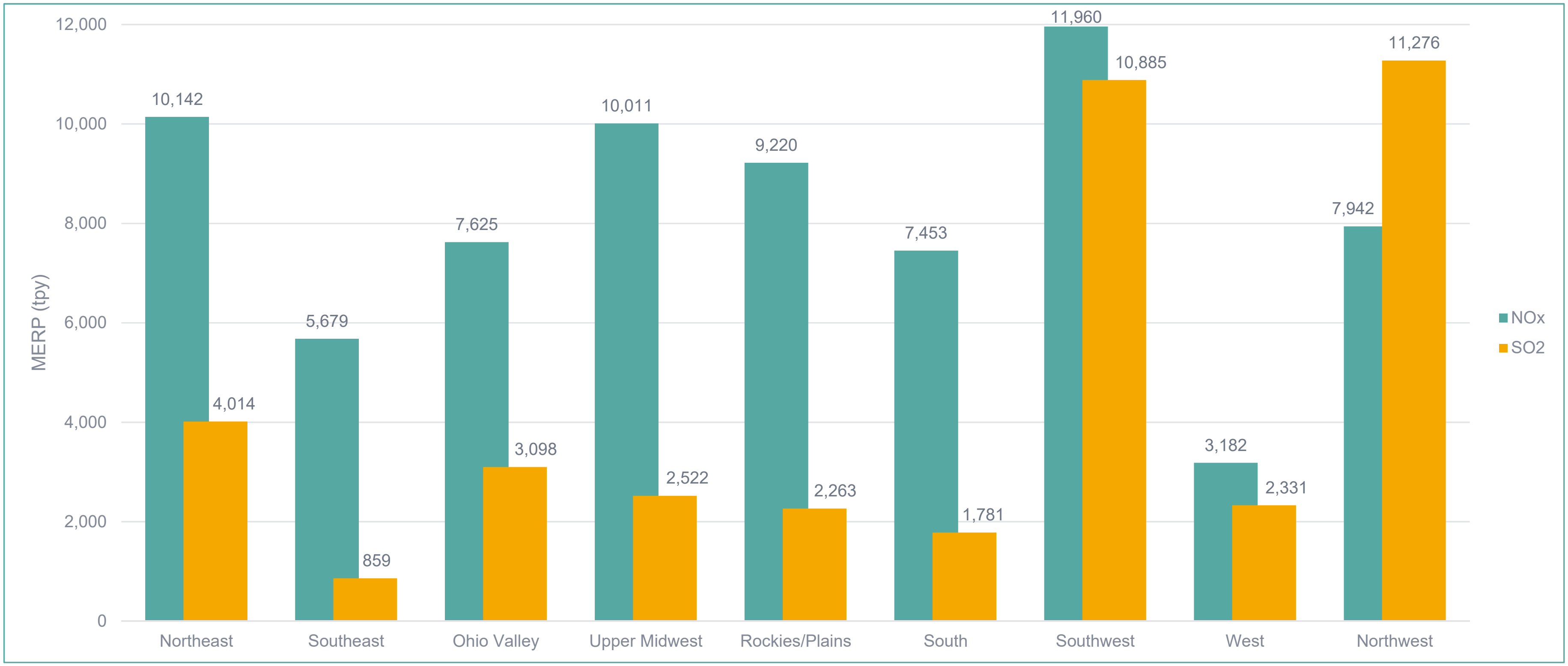
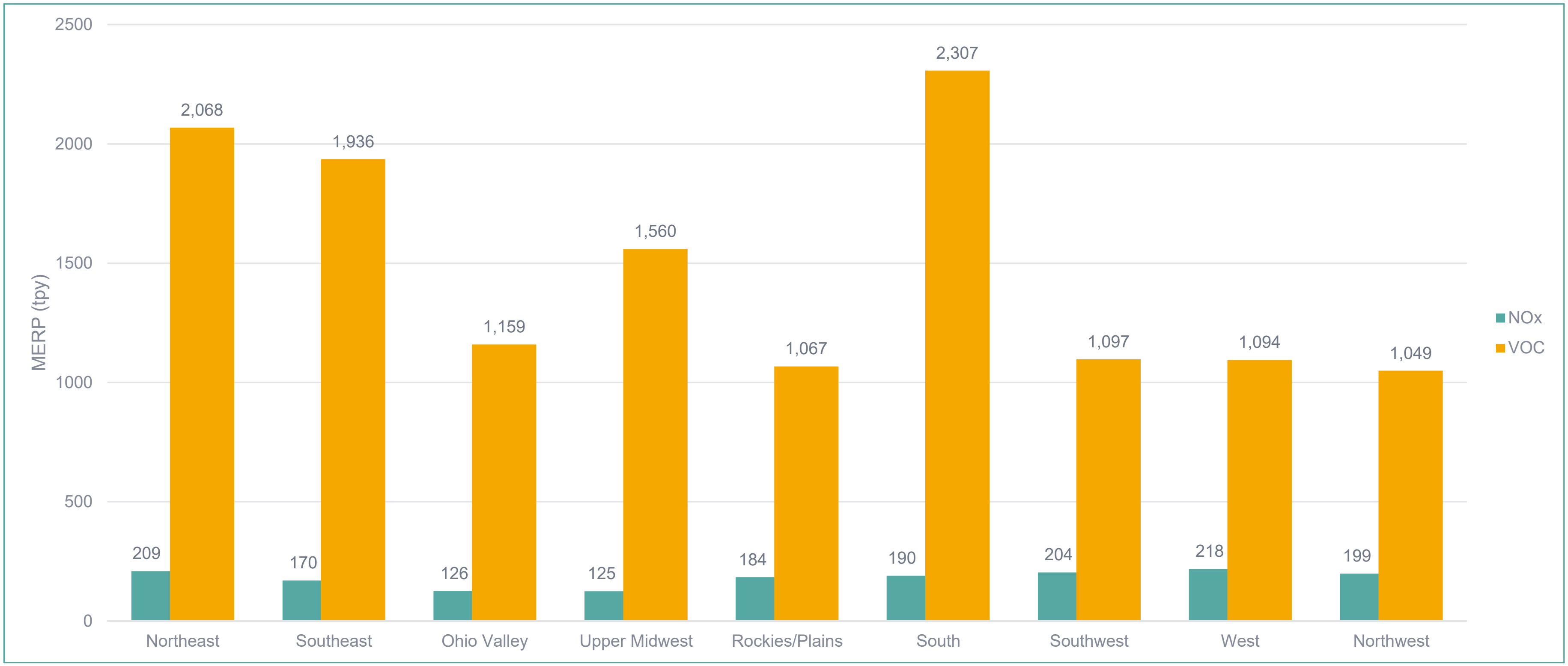
Regional MERPs – $PM_{2.5}$ Annual

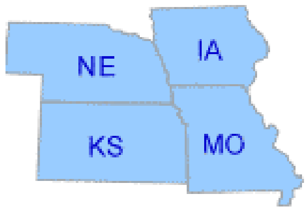


Regional MERPs – Ozone 8-hr



State/Agency Guidance

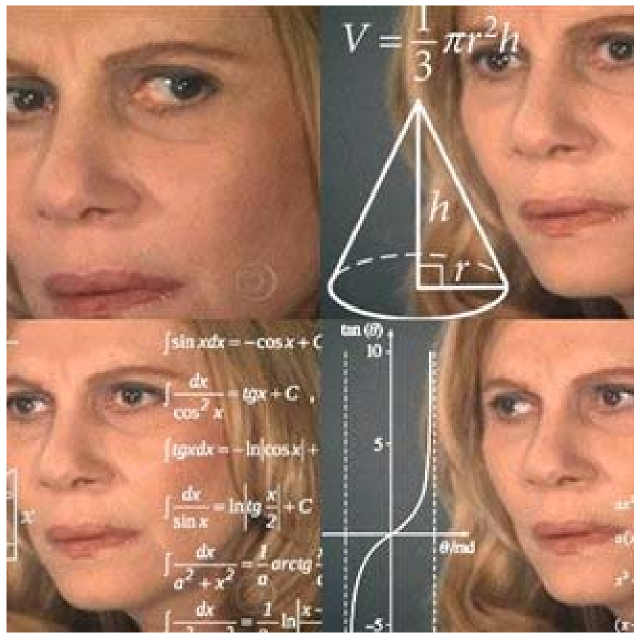
- Individual state/agency guidance
  - Check with agency before submitting protocol/application
  - Iowa – Follow EPA guidance, use MERPs from Upper Midwest zone
  - Nebraska – State guidance in development
  - Kansas
  - Missouri – Follow EPA guidance



Other Relevant Guidance

- $PM_{2.5}$ and Ozone SILs Guidance – April 2018
  - Revised SILs for $PM_{2.5}$
  - First time Ozone has had a SIL
- June 2018 Regional, State, and Local Modeling Workshop
  - 2014 $PM_{2.5}$ Modeling Guidance to be revised (soon?)
  - No more qualitative analyses - use MERPs
  - Do $PM_{2.5}$ Modeling + MERPs when:
    - $PM_{2.5}$ Primary, NO_2, **or** SO_2 ≥ SER
    - Analysis includes all three, regardless of emission rates
  - Some exceptions for remote areas (AK)
- June 2019 Webinar
  - Additional example senarios

MERPs in Action



Case Study Project

- Company XYZ proposes a chemical process plant near Lake Charles, LA
- Natural Gas Combustion (boilers, process heaters)
- Hydrocarbon Storage, loading, fugitives

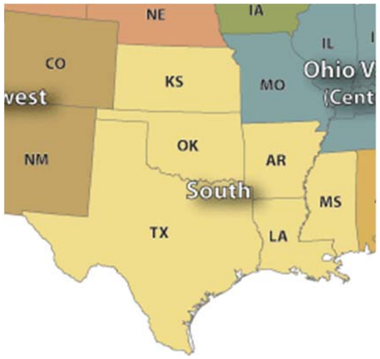
Case Study Project

- Step 1: Calculate PTE
  - Major for PM_{10}, $PM_{2.5}$, NO_X, CO, and VOC (Listed source)
  - SO_2 below SER
  - PM_{10}, $PM_{2.5}$, NO_X, CO, and SO_2 from combustion
  - VOC and HAP from storage tanks, loading, fugitives
- Step 2: Conduct SIL Modeling
  - PM_{10}, $PM_{2.5}$, NO_2, and CO

Case Study Project

- Step 3: Determine Appropriate MERPs
  - Option 1: Conservative regional MERPs (Table 4-1)

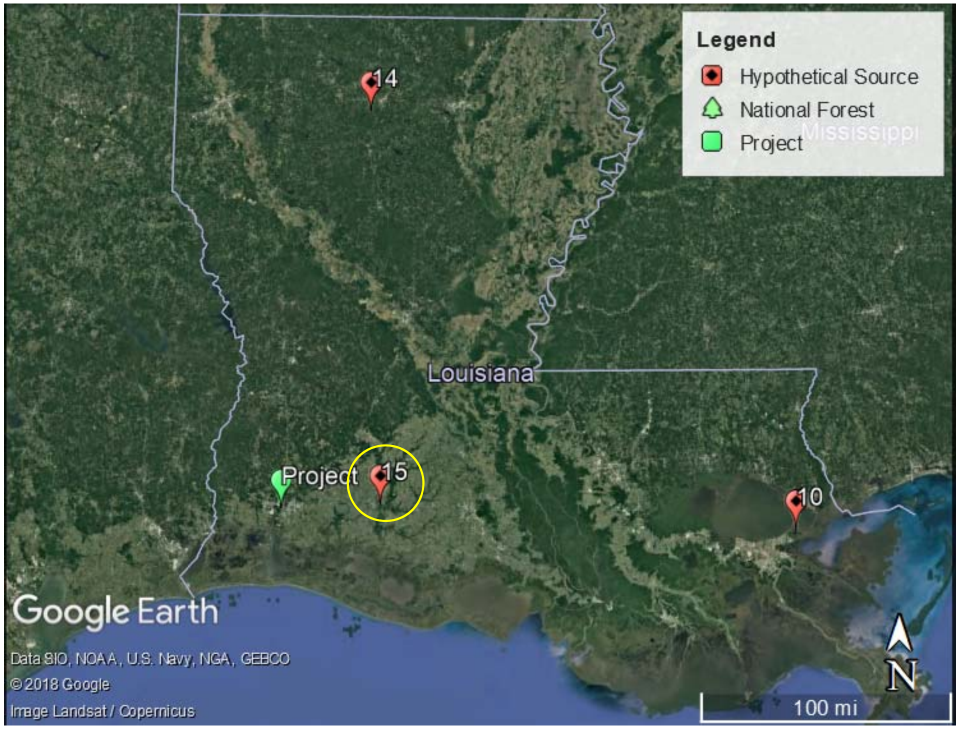
Standard	SO_2	NO_X	VOC
$PM_{2.5}$ 24-hr	274	1,881	--
$PM_{2.5}$ Annual	1,781	7,453	--
Ozone	--	190	2,307



Case Study Project

- Option 2: Review MERPs Guidance Spreadsheet
  - Identify most representative hypothetical source(s)
  - Consider:
    - Proximity to project
    - Latitude
    - Terrain features/elevation
    - Landuse (urban/rural)
    - Waterbodies
    - Climate Region

Hypothetical Sources in Louisiana



Nearby Terrain Ht.

Nearby Urban Frac.

Case Study Project – Selecting MERPs

- Use most conservative MERPs for selected source, or
- Keep refining
  - Release Heights: High or Low?
    - High for NO_X and SO_2 (combustion stacks)
    - Low for VOC (tanks, loading, fugitives)
  - Emission Rates: 500, 1000, or 3000 tons per year?
    - Emissions of all pollutants < 500 tpy
    - Use 500 tpy source

$PM_{2.5}$ MERPs for Selected Source

Standard	Precursor Emission Rate (tpy)	Src. Height	SO_2 MERP (tpy)	NO_X MERP (tpy)
PM2.5 Daily	500	L	326	3,185
		H	1,529	8,275
	1000	L	274	3,101
		H	1,110	7,342
	3000	H	882	6,751
	Lowest		*274*	*3,185*

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Case Study Project – Selected MERPs

Standard	Src. Emission Rate (TPY)	Precursor	Src. Height	MERP (tpy)
$PM_{2.5}$ Daily	500	NO_X	H	8,275
	500	SO_2	H	1,529
$PM_{2.5}$ Annual	500	NO_X	H	41,426
	500	SO_2	H	8,375
Ozone	500	NO_X	H	199
	500	VOC	L	4,378

Case Study Project – Estimating Impacts

- Step 4: Estimate Precursor and Primary Impacts
  - Use the MERPs equation to solve for impacts
  - $Air\ Quality\ Impact\ [ppb\ or\ \mu g/m^3] = SIL\ [ppb\ or\ \mu g/m^3] \times \frac{Precursor\ PTE\ [tpy]}{MERP[tpy]}$
  - Evaluate for:
    - Each precursor and each NAAQS
    - Each operating scenario, as applicable

Case Study Project – Estimating Impacts

$$Air\ Quality\ Impact\ [ppb\ or\ \mu g/m^3] = SIL\ [ppb\ or\ \mu g/m^3] \times \frac{Precursor\ PTE\ [tpy]}{MERP[tpy]}$$

Precursor	PTE (tpy)	$PM_{2.5}$ 24-hr ($\mu g/m^3$)	$PM_{2.5}$ Annual ($\mu g/m^3$)	Ozone (ppb)
NO_X	175	0.025	0.0008	0.879
SO_2	15	0.012	0.0004	--
VOC	200	--	--	0.046
Total Secondary	--	0.037	0.0012	0.925
SIL Modeling	--	1.04	0.10	--
Combined Impact		**1.08**	**0.10**	**0.93**
SIL		*1.2*	*0.2*	*1*

Summary and Outlook

- Useful tool to provide regional/local-specific estimates
- Easier than a photochemical model!
- Developing topic with changing guidance/procedures
  - New MERPs may be added – Some states have few or no hypothetical sources or specialized needs
  - State implementation of MERPs
  - Maximum by distance
- EPA 12th Modeling Conference – tomorrow!
  - New $PM_{2.5}$ Modleing guidance soon?

Contact Information

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Questions?

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