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How $PM_{2.5}$ MERPs Measure Up: An AERMOD Case Study

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Introduction (1 of 2)

- The final rule that promulgates revisions to the Guideline on Air Quality Models (Guideline) was published January 17, 2017.
- Fine particulate matter ($PM_{2.5}$) modeling guidance for modeling primary $PM_{2.5}$ and secondary $PM_{2.5}$.
  - Tiered approaches to address secondary chemical formation of $PM_{2.5}$ (and ozone) associated with single emission point sources using the concept of Modeled Emission Rate for Precursors (MERPs) as a first tier approach.
- The final rule (Section 8) also included updated guidance on considerations for representation of nearby sources in regulatory modeling.
  - More weight has been given to representing nearby sources through use of monitored data vs. explicitly modeling large numbers of nearby sources through AERMOD.

Introduction (2 of 2)

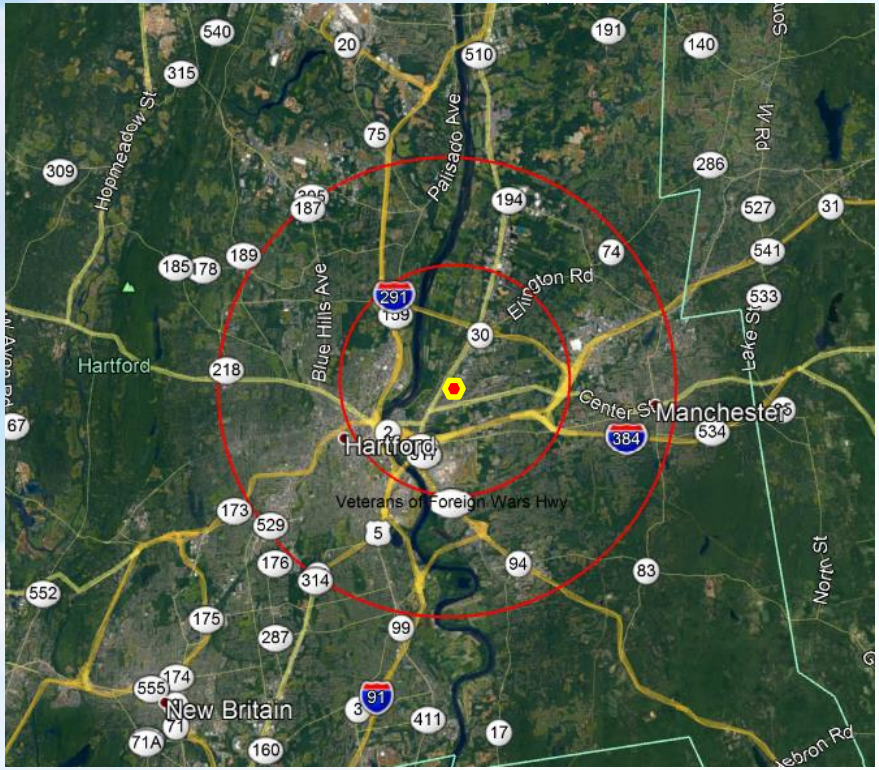
- Hypothesis
  - If local sources were modeled surrounding a PM2.5 monitor in CT, then the resulting concentrations may show the relative impacts of nearby sources vs. more distant, mobile, non-permitted sources expected from the monitor data.
- MERPs guidance applies to sources that are being permitted
  - Secondary formation contribution from other sources?
- How this methodology comes into play in "real-life" in Connecticut?
  - For facilities triggering PSD for NOx and SO2, precursor's impacts on secondary $PM_{2.5}$ formation could be addressed using MERPs under EPA's Tier 1 approach.
  - Understanding impacts from local sources, regional sources, and background monitor data play a role in evaluating NAAQS compliance including expected secondary $PM_{2.5}$ impacts.

Purpose

- This presentation presents a case study using EPA's latest guidance for evaluation of ambient air quality impacts of primary and secondary $PM_{2.5}$.
  - **Part 1**: A stationary source inventory of primary $PM_{2.5}$ emissions (~65 facilities, ~175 emission sources) are modeled
    - Results are compared to the readings of the existing background monitor at East Hartford - McAuliffe Park.
    - The results of this preliminary analysis are used with other preliminary information to help justify the development of representative nearby source inventories that adequately represent local and regional contributions to $PM_{2.5}$ concentrations.
  - **Part 2:** A hypothetical new plant is assessed for nearfield NAAQS compliance using current EPA guidance and tools, including SILs and MERPs, to understand the feasibility of modeling a new fossil fuel fired electric utility in CT.

AERMOD Modeling Analysis for Part 1 (1 of 3)

- Study Area
  - All stacks with actual PM emissions and within 5 km radius
  - All stacks with actual PM emissions >15 tpy and within 10 km radius
  - All stacks with actual PM emissions >50 tpy and within 20 km radius
  - All stacks with actual PM emissions >500 tpy and within 50 km radius (3 additional sources outside radius)



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AERMOD Modeling Analysis for Part 1 (2 of 3)

- AERMOD Setup – Version 16216r
  - Actual emissions and stack parameter data from CTDEEP's Air Inventory Radius Search Tool
- Meteorological Data
  - Bradley International Airport (2012-2016)
- Background Monitor data (2014-2016) for East Hartford - McAuliffe Park from CTDEEP's website
  - 24-hr $PM_{2.5}$: 18 µg/m^3 Annual $PM_{2.5}$: 7.1 µg/m^3

AERMOD Modeling Analysis for Part 1 (3 of 3)

- Modeling Results Analysis
  - Modeled concentration in AERMOD shows a much lower concentration than the background monitor design values.
    - 24-hr $PM_{2.5}$: 0.23 µg/m^3
    - Annual $PM_{2.5}$: 0.07 µg/m^3

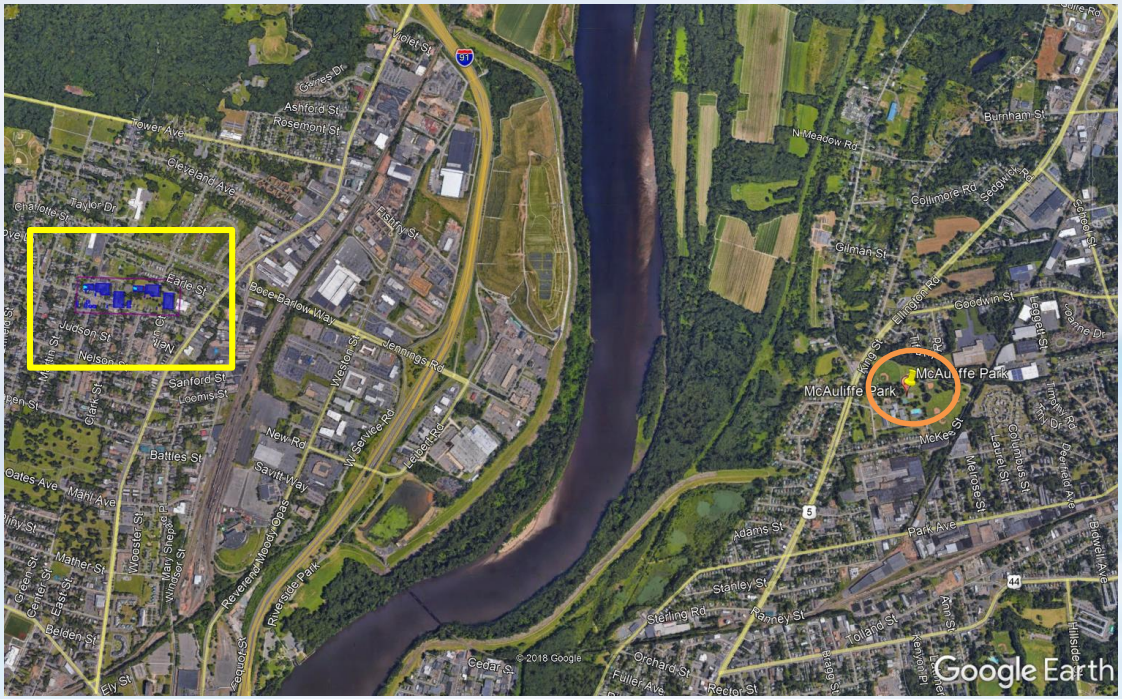
Part 1 Conclusions

- The initial modeling analysis indicates that the East Hartford monitor is impacted less by primary $PM_{2.5}$ from local stationary sources and more by other sources
  - This finding is supported by regional photochemical modeling completed to support CSAPR rule development
- In a nearfield PSD modeling analysis using AERMOD, these conclusions support a heavier reliance on ambient monitor data rather than explicitly modeled regional sources in AERMOD for assessments of cumulative NAAQS compliance
- Care must be taken when representing nearby sources to avoid double counting from explicitly modeled and background monitor.
  - EPA supports this approach where justifiable in Section 8.3.3 of Guideline.
- Next step: "Mock Facility" model to understand how secondary formation using MERPs may be applied in a possible real-life scenario in a similar location as Part 1.

AERMOD Modeling Analysis for Part 2 (1 of 2)

- Modeled a "Mock Facility" (power plant) with same meteorological data and AERMOD version as in Part 1
  - 2 Combined Cycle Combustion Turbines (Worst case load)
  - Auxiliary Boiler
  - 2 Emergency Generators & a Fire Pump
  - Buildings, fence line, and a discrete receptor grid

AERMOD Modeling Analysis for Part 2 (1 of 2)



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AERMOD Modeling Analysis for Part 2 – SIL Modeling Results

- Modeled concentration in AERMOD shows results that exceed the SIL. Therefore, a NAAQS analysis, including MERPs, is required.
- SIL Results:
  - 24-hr $PM_{2.5}$: 7.04 µg/m^3
  - Annual $PM_{2.5}$: 1.99 µg/m^3
  - Impact of Secondary Formation on SIL using MERPs
  - Most Conservative (Lowest) Illustrative MERP Values (ton per year) by Precursor, Pollutant and Region (Source: MERPs Data Distribution and Errata Memo February 2017)
    - EUS – NO_X – 24-hr $PM_{2.5}$: 2,295 tpy
    - EUS – NO_X – Annual $PM_{2.5}$: 10,144 tpy
    - EUS – SO_2 – 24-hr $PM_{2.5}$: 628 tpy
    - EUS – SO_2 – Annual $PM_{2.5}$: 4,013 tpy
  - Mock Facility PTE
    - NO_X = 264 tpy
    - SO_2 = 135.8 tpy

AERMOD Modeling Analysis for Part 2 – SIL Secondary Impacts

- Calculation of Additive Secondary Impacts on 24-hr $PM_{2.5}$
  - (1.2 µg/m^3)*[(264 tpy NO_X from sources/2,295 tpy NO_X annual $PM_{2.5}$ MERP) + (135.8 tpy SO_2 from sources/628 tpy SO_2 daily $PM_{2.5}$ MERP)] = 0.4 µg/m^3
  - =0.4 µg/m^3 is the secondary formation impacts using MERPs for SIL Concentration
  - **0.4 µg/m^3 + 7.04 µg/m^3 = 7.44 µg/m^3**
- Calculation of Additive Secondary Impacts on Annual $PM_{2.5}$
  - (0.3 µg/m^3)* [(264 tpy NO_X from sources/10,144 tpy NO_X annual $PM_{2.5}$ MERP) + (135.8 tpy SO_2 from sources/4,013 tpy SO_2 daily $PM_{2.5}$ MERP)] = 0.018 µg/m^3
  - =0.018 µg/m^3 is the secondary formation impacts using MERPs for SIL Concentration
  - **0.018 µg/m^3 + 1.99 µg/m^3 = 2.00 µg/m^3**

- Modeled concentrations of primary $PM_{2.5}$ + Secondary formation of $PM_{2.5}$ using MERPs exceed the SIL, therefore NAAQS modeling is required

AERMOD Modeling Analysis for Part 2 - NAAQS

- Calculation of Additive Secondary Impacts
  - NAAQS Results for primary formation of $PM_{2.5}$:
    - 24-hr $PM_{2.5}$: 6.36 µg/m³ (H8H averaged over 5 years)
    - Annual $PM_{2.5}$: 1.99 µg/m³ (averaged over 5 years)
  - Primary $PM_{2.5}$ + Regional Sources + Background + Secondary $PM_{2.5}$ was compared to the NAAQS
    - 24-hr $PM_{2.5}$: 6.36 + 18 + 0.4 = 24.76 µg/m³
      Annual $PM_{2.5}$: 1.99 + 7.1 + 0.018 = 9.11 µg/m³
    - Based on Part 1 of the assessment, we did not model additional nearby sources explicitly in AERMOD because the background monitor represents them already as well as other more distant sources

Part 2 Conclusions

- "Mock Facility" does not exceed the NAAQS.
- Draft MERP guidance does not give different values to use for NAAQS vs. SIL even though the standards have different forms for 24-hour.
  - Secondary formation represented in NAAQS analysis is inherently conservative.
- MERPs can be a useful tool to ease regulatory permitting burden in cases with relatively low precursor emissions.

Questions

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