Impact of Mobile Source Emissions on Air Quality

EPA Presentation to MSTRS
May 31, 2017
Why did EPA do this work?

• Periodically assess mobile source contributions to ambient concentrations of pollutants
  • Contribution of mobile source PM$_{2.5}$ precursors to ambient PM$_{2.5}$ concentrations
  • Contribution of mobile source NOx and VOC to ambient ozone concentrations
• Can provide useful information to help guide future assessments and control needs
Modeling Methodology

• 2011 v6.2 emissions modeling platform
  • MOVES 2014
  • NONROAD 2008

• CAMx photochemical model
  • 2011 and 2025
  • 48 state domain

• Source Apportionment Technology for Particulate Matter (PSAT) and ozone (OSAT)
  • PSAT includes contribution from NOx to PM$_{2.5}$ nitrate ion, SO$_2$ to PM$_{2.5}$ sulfate ion, NH$_3$ to PM$_{2.5}$ ammonium ion, primary EC, primary OC, other primary PM$_{2.5}$
  • OSAT includes contribution from NOx and VOC to ozone

• 17 mobile source sectors
  • Merged into 11 mobile source categories
Caveats / Limitations for Modeling Projections

• Inventory is a snapshot in time, constantly being updated to reflect the latest science and data

• Nonroad inventory (including rail and marine) is less certain than onroad inventory
  • Emission factors, population, activity, and allocation (temporal and spatial) are being updated

• Meteorology inputs are only one year - 2011
Mobile Source Inventory Inputs
Nitrogen Oxide (NO_x) Emissions from 11 Mobile Source Categories

- Aircraft
- Rail
- C3 marine
- C1C2 marine
- Onroad Heavy duty diesel
- Onroad heavy duty gas + CNG
- Onroad light duty
- Nonroad diesel
- Nonroad lawn & garden residential
- Nonroad lawn & garden commercial
- Nonroad recreational (incl. pleasure craft)
Volatile Organic Compound (VOC) Emissions from 11 Mobile Source Categories

2011 vs. 2025

- Aircraft
- Rail
- C3 marine
- C1C2 marine
- Onroad Heavy duty diesel
- Onroad heavy duty gas + CNG
- Onroad light duty
- Nonroad diesel
- Nonroad lawn & garden residential
- Nonroad lawn & garden commercial
- Nonroad recreational (incl. pleasure craft)
Fine Particulate Matter (PM$_{2.5}$) Emissions from 11 Mobile Source Categories

- Aircraft
- Rail
- C3 marine
- C1C2 marine
- Onroad Heavy duty diesel
- Onroad heavy duty gas + CNG
- Onroad light duty
- Nonroad diesel
- Nonroad lawn & garden residential
- Nonroad lawn & garden commercial
- Nonroad recreational (incl. pleasure craft)
Air Quality Model Outputs

Presented in the following slides from 3 perspectives:

• Pie charts of contribution from mobile sources
• Bar charts of contribution by mobile source sectors
• Maps of contribution by mobile source sector
Contribution to PM$_{2.5}$ Concentration in 2025

- Boundary Conditions: 21%
- Mobile sources: 15%
- Biogenics, Dust, Ag: 6%
- Point, Nonpoint, Fires: 58%
Breakdown of Mobile Source Contributions to PM$_{2.5}$ Concentration in 2025

- **Aircraft**: 10%
- **Rail**: 8%
- **C3 marine**: 5%
- **C1c2 marine**: 5%
- **Onroad HDD**: 12%
- **Onroad HD gas and CNG**: 4%
- **Onroad light duty**: 20%
- **Nonroad lawn and garden residential**: 4%
- **Nonroad lawn and garden commercial**: 7%
- **Nonroad diesel**: 20%
- **Nonroad rec including pleasure craft**: 5%
Mobile Source Contributions to Ambient PM$_{2.5}$ in 2025

Nonroad Recreational  Nonroad Diesel  Lawn & Garden Comm

Onroad Light-Duty  Heavy-Duty Diesel  Rail

C3 Marine  C1/C2 Marine  Aircraft LTO

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Mobile Source Contributions to Ambient PM$_{2.5}$: primary (top) and secondary (bottom)

Onroad Light-duty: 2025 primary

Onroad Heavy-duty Diesel: 2025 primary

Onroad Light-duty: 2025 secondary

Onroad Heavy-duty Diesel: 2025 secondary
Contribution to Ozone Concentration in 2025

- Boundary Conditions: 37%
- Mobile sources: 24%
- Biogenics, Dust, Ag: 24%
- Point, Nonpoint, Fires: 15%
Breakdown of Mobile Source Contributions to Ozone Concentration in 2025

- Aircraft: 4%
- Rail: 10%
- C3 marine: 7%
- C1C2 marine: 4%
- Onroad HDD: 22%
- Onroad HD gas and CNG: 1%
- Onroad light duty: 23%
- Nonroad lawn and garden residential: 1%
- Nonroad lawn and garden commercial: 3%
- Nonroad diesel: 15%
- Nonroad rec including pleasure craft: 9%
## Mobile Source Contributions to Ambient Ozone in 2025

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Map Image</th>
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<tbody>
<tr>
<td>Nonroad Recreational</td>
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<td>Rail</td>
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Mobile Source Contributions to Ambient Ozone: NO\textsubscript{X} (top) and VOC (bottom)
Example Application of Results

• Seasonal comparisons
• Trends over time, comparing 2011 to 2025
Seasonal Comparison: Nonroad Recreational

January 2011

July 2011
Primary PM$_{2.5}$ Trends: 2011 (top) compared to 2025 (bottom)

Aircraft LTO (Jul)  
Onroad HDD (Jul)
Wrap Up

Next Steps
• Submit to peer reviewed journal this summer

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Mobile Source Contributions to Ambient PM$_{2.5}$: primary (top) and secondary (bottom)
Mobile Source Contributions to Ambient PM$_{2.5}$: primary (top) and secondary (bottom)
Mobile Source Contributions to Ambient Ozone: NO$_X$ (top) and VOC (bottom)