Examination of the Multiplier Used to Estimate PM2.5 Fugitive Dust Emissions from PM10

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AQ Models Consistently Overestimate the Ambient Concentration of Crustal Matter

Main Sources of Crustal Matter in the EI:
- **Fugitive Dust**: Unpaved roads, Agricultural tilling, Construction, Windblown dust, Fly ash
- Emissions processor / speciation factors

Huge Disparity Between Modeled & Ambient Data
- Ambient Measurements used to estimate crustal matter
  - < 1 ug/m³ in most of US (> 1 ug/m³ in much of Southwest & CA)
  - AQ Models estimate several times that amount
- **Emissions** – Crustal matter and carbon EI are comparable (2.5M TPY)
  - Carbon is ~ 3 to 5 times higher than crustal matter in ambient air
- **Models** – may oversimplify the removal processes for fugitive dust
  - Plume and grid models have different issues
What’s Wrong with Fugitive Dust Emissions Estimates?

■ The “Usual” Culprits…
  □ Emission Factors
  □ Activity Data

■ Modeling Deficiencies (esp. Near-source Removal):
  □ Fugitive dust is released near the ground and surface features often capture the dust near its source.
  □ (See http://www.epa.gov/ttn/chief/emch/invent/)
What’s Wrong with Fugitive Dust Emissions Estimates?

- The “Usual” Culprits…
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  - Activity Data

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- PM-Other:
  - Emission processors currently “lump” the unresolved PM2.5 mass with the crustal mass into PM-Other.
  - Inflated estimates of PM-Other are often misinterpreted as an overestimate of FD emissions – cause confusion & EI credibility issues.

- Multiplier:
  - PM2.5 emission estimates are derived from PM10.
  - The **Multiplier** used to estimate the PM2.5 fraction of PM10 appears to overestimate the PM2.5 fraction of PM10.
Historical Perspective on the Multiplier

- **PM2.5 FD Emissions Testing**
  - Most testing done many years ago using Cascade impactors
  - Most testing was for total PM w/ size distributions derived from impactor stages.

- **Bias** ~ Always concern for carryover (bounce) of larger particles to the lower stages.
  - Previous attempts to compensate, correct data.
  - Ongoing WRAP-funded testing will provide added insight on impactor bias.
## PM2.5 : PM10 Multiplier (Updated 1996)

<table>
<thead>
<tr>
<th>Category</th>
<th>Multiplier (PM2.5 / PM10)</th>
<th>Principal Supporting Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paved Roads</td>
<td>0.25 (0.2)</td>
<td>“Profiler” tests using cascade impactor</td>
</tr>
<tr>
<td>Unpaved Roads</td>
<td>0.15</td>
<td>“Profiler” tests using cascade impactor, dichots,</td>
</tr>
<tr>
<td>Construction, Ag &amp; Wind</td>
<td>0.15 – 0.2</td>
<td>Unpaved road tests, Resuspension chamber, Wind tunnel</td>
</tr>
</tbody>
</table>

**Note:** Emissions-weighted average multiplier ~ 0.17
Paved Roads – Recent Information

- **Revision to AP-42 (2003)**
  - 0.2 ~ reduced from 0.25 in earlier Version of AP-42 due to lower est. for major arterials & freeways

- **Transportation Research Board (2003)**
  - 0.1 ~ receptor modeled samples near arterials & collectors

- **Dust Traker in Idaho (2002)**
  - .06 ~ using real-time light scattering devices to est. emissions

- **Construction site entrance (2003)**
  - .03 ~ using new design hybrid sampler
  - Hybrid sampler 3x lower than cascade impactor

Current multiplier ~ 0.2
Unpaved Roads – Recent Information

  - 0.1 ~ error found in earlier work. Earlier ratio was 0.15
- AP-42 Revision: Western Surface Coal Mine (1998)
  - 0.12 ~ for unpaved roads
  - 0.07 ~ using roadside dichots (0.25 from side-by-side impactor)
- Miscellaneous References
  - 0.06 ~ Traker tests in Idaho using light scattering method
  - 0.1 ~ previous ref. to work by IL Water Survey appears valid
  - Previous est. of 0.25 from work in AZ couldn’t be verified

Current multiplier ~ 0.15
Construction, Ag & Wind – Recent Information

- AP-42 Revision: Western Surface Coal Mine (1998)
  - 0.04 to 0.08 ~ for scrapers/ graders (similar to construction)

- Agricultural Field Dust in CA (2004)
  - 0.12 ~ using samplers located near agricultural operations

  - 0.1 ~ ambient sampling alongside Owens Lake

Current multiplier ranges from 0.15 to 0.2
Indications from Ambient Observations & Other Information

- **IMPROVE Ambient Network (1999-2002)**
  - 0.11 to 0.12 ~

- **Trace Element Analysis, San Joaquin Valley (2003)**
  - 0.06 ~ for samples collected near agricultural dust sources

- **Resuspended Soil Samples (2002)**
  - 0.1 ~ samples collected in continuous flow resuspension chamber

Current multiplier averages 0.17 over all sources
## Summary of New Information

<table>
<thead>
<tr>
<th>Category</th>
<th>Current Multiplier</th>
<th>Range of New Data</th>
<th>Midpoint of New Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paved Roads (lower traffic)</td>
<td>0.20</td>
<td>0.3 to 0.10</td>
<td>0.09</td>
</tr>
<tr>
<td>Unpaved Roads</td>
<td>0.15</td>
<td>0.10 to 0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Construction, Ag &amp; Wind</td>
<td>0.15 to 0.20</td>
<td>0.06 to 0.12</td>
<td>0.1</td>
</tr>
<tr>
<td>Other Indicators</td>
<td>na</td>
<td>0.06 to 0.11</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Current multiplier averages 0.17 over all sources
Conclusions

- **Crustal materials** are a relatively small part of PM2.5 in the ambient air,
  - but their impact is consistently **overestimated**.
  - The “Usual” Culprits are **NOT** the main problem.
- The **Multiplier** appears to **overestimate** the PM2.5 fraction of PM10 **by roughly 70%**.
  - **Waiting for WRAP work completion** to make specific recommendation
- **Note: Other issues are also under investigation:**
  - **Near-source Removal:** Fugitive dust is released near the ground and surface features often capture the dust near its source. (See [http://www.epa.gov/ttn/chief/emch/invent/](http://www.epa.gov/ttn/chief/emch/invent/))
  - **PM-Other:** Emission processors currently “lump”/combine the unresolved PM2.5 mass with the crustal mass in the speciation step as PM-Other. This results in inflated estimates of PM-Other, which is often mis-interpreted as an over estimate of Crustal Matter.