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/)

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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 over estimate 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)

Category	Multiplier (PM2.5 / PM10)	Principal Supporting Data
Paved Roads	**0.25 (0.2)**	"Profiler" tests using cascade impactor
Unpaved Roads	**0.15**	"Profiler" tests using cascade impactor, dichots,
Construction, Ag & Wind	**0.15 – 0.2**	Unpaved road tests, Resuspension chamber, Wind tunnel

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

- **Re-look: PEDCo/MRI Surface Mining Report (2003)**
  - 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
- **MRI road Testing ~ Denver, Reno, Raleigh (1997)**
  - 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
- **Owens Lake Source-oriented Sampling (2004)**
  - 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

Category	Current Multiplier	Range of New Data	Midpoint of New Data
Paved Roads (lower traffic)	0.20	0.3 to 0.10	0.09
Unpaved Roads	0.15	0.10 to 0.12	0.11
Construction, Ag & Wind	0.15 to 0.20	0.06 to 0.12	0.1
Other Indicators	na	0.06 to 0.11	0.1

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/)
  - **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.