Impacts of Measurement Uncertainty and Emissions Variability on Modeled Impacts

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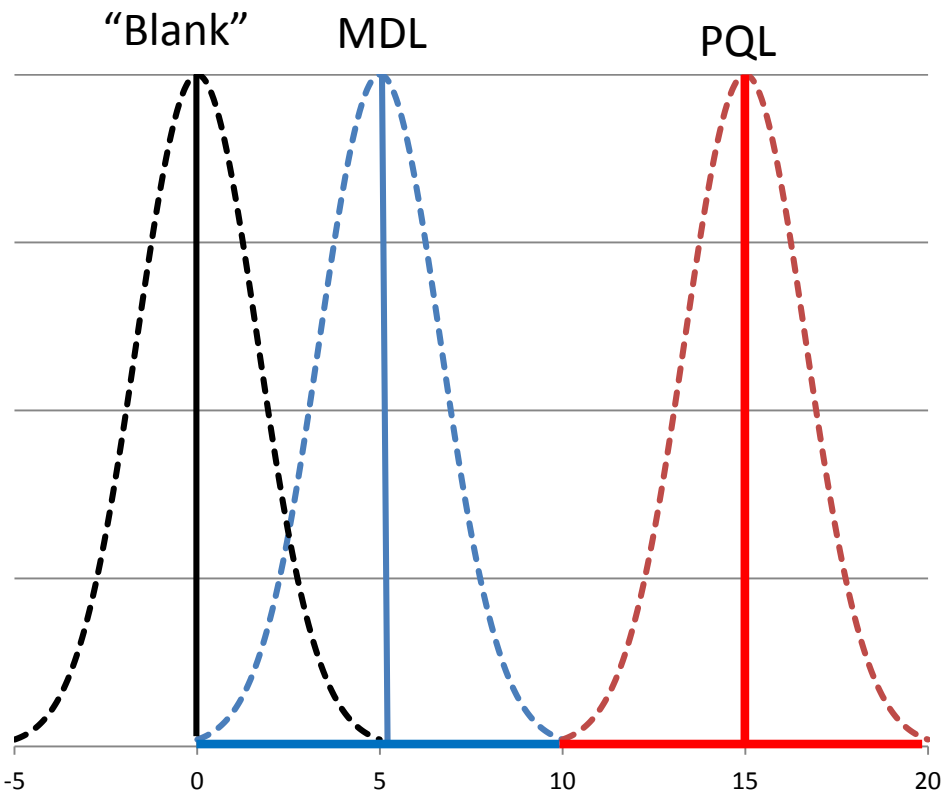
Outline

- Measurement Uncertainty
  - Detection & Quantitation Level Issues
- Measurement Uncertainty on Low Pollutant Concentration Sources
  - Example: $PM_{2.5}$ Emissions from Paper Machines
  - Impacts of Detection Level Handling
- Emissions Variability

Measurement Uncertainty



- Inherent Uncertainty in All Measurements
  - Uncertainty is independent of the value, so at low levels ***relative uncertainty*** can be very high
- Minimum Detection Level (MDL)
  - 99% confidence that response is distinguishable from "Blank"
  - EPA methods have defined MDLs

Low Pollutant Concentration Sources Example: $PM_{2.5}$ from Paper Machines

- Low Pollutant Concentrations = high levels of relative uncertainty
  - Data < MDL – cannot say with confidence that pollutant is even present

- Paper Machines
  - Multiple vents, low $PM_{2.5}$ concentration
  - High flows and moisture, low-elevation

Low Pollutant Concentration Sources Example: $PM_{2.5}$ from Paper Machines

Source/ Vent ID	Length of Run (hr)	$PM_{2.5}$	CPM
		Detected Mass (mg)	
1	8	1.53	4.00
2	8	1.31	5.40
3	8	0.86	3.00
4	4	1.10	3.70
5	4	0.30	4.00
6	4	0.00	6.20
7	16	1.80	2.07
8	16	2.51	1.51
Method 201A/202 DL		2.00	6.00
Orange Data is < MDL		Yellow Data is >MDL, below PQL	

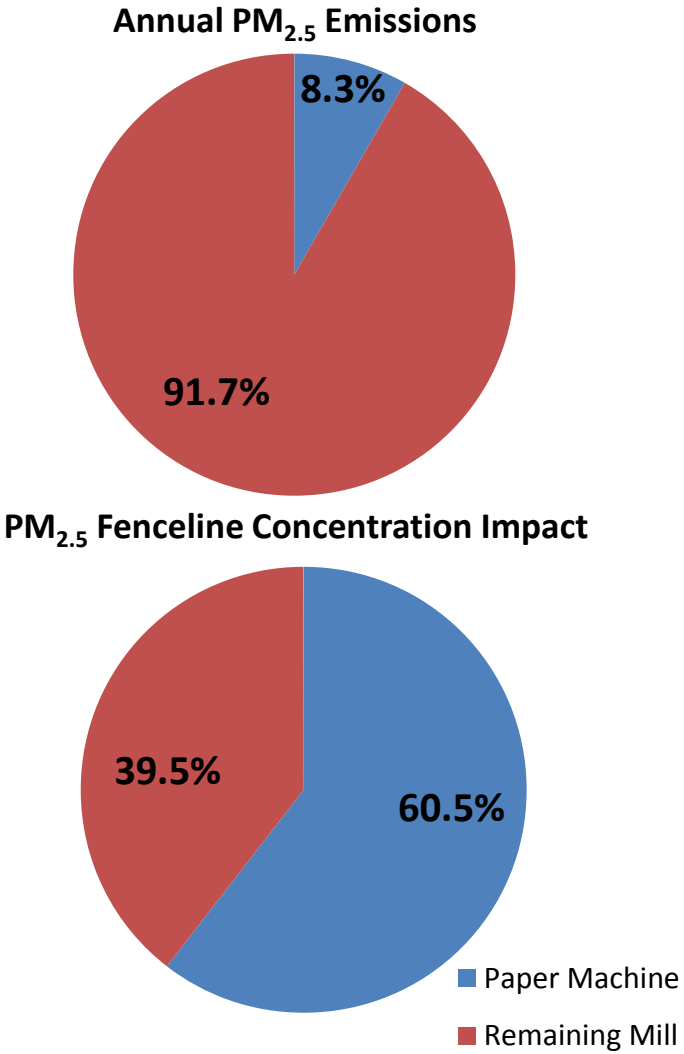
Except in 2 cases, cannot say with confidence that filterable $PM_{2.5}$ or CPM is present

Low Pollutant Concentration Sources Example: $PM_{2.5}$ from Paper Machines

- Given the source characteristics, total source $PM_{2.5}$ emissions from paper machines are highly dependent on how data below MDL are handled

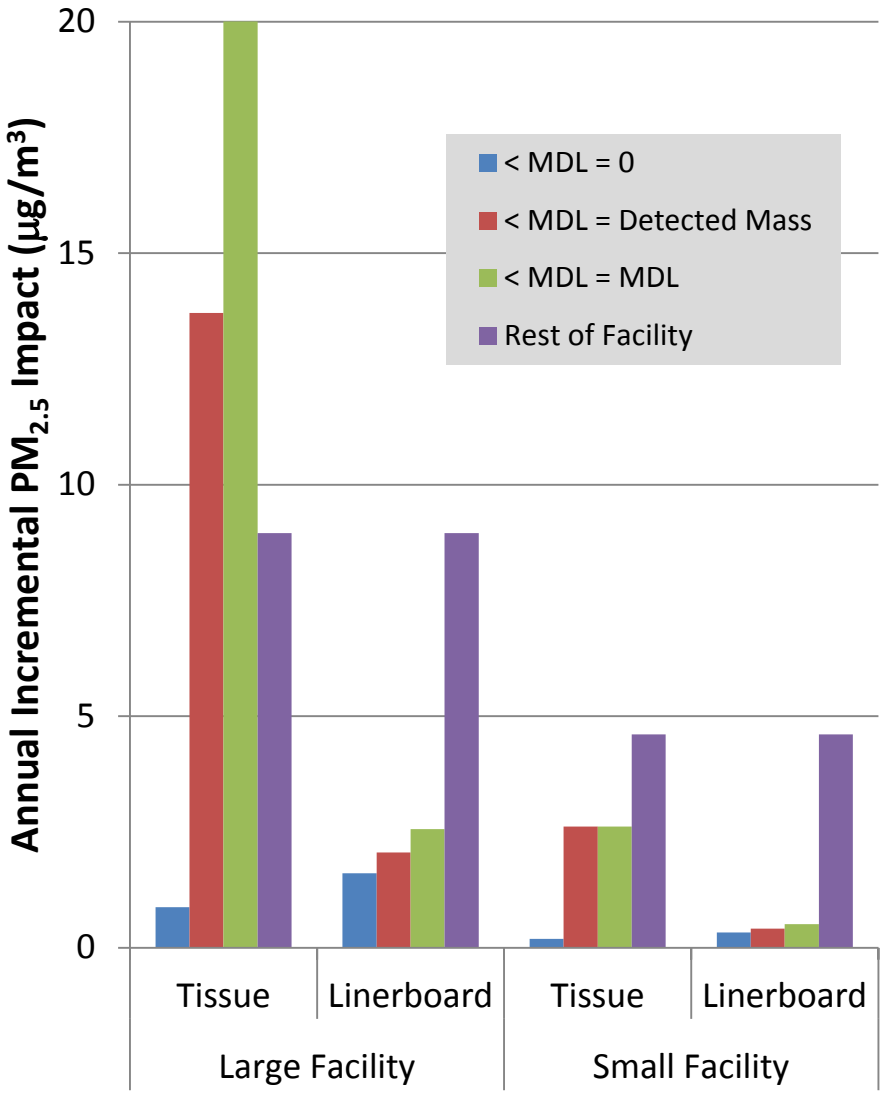
$PM_{2.5}$ Emissions, tons/yr				
		Method Used to Treat Vent-Level Data < MDL		
		@ Detected Mass	@ MDL	Data <MDL = 0
Small Paper Machine	Tissue	18.5	27.8	1.4
	Linerboard	3.0	3.6	2.4
Large Paper Machine	Tissue	91.4	138	5.9
	Linerboard	13.8	17.2	10.8

Low Pollutant Concentration Sources Example: $PM_{2.5}$ from Paper Machines



- Concentration impacts evaluated for a model integrated pulp mill facility
- These sources are fugitive in nature, have low release points and have disproportionate impact on fenceline concentrations
- Large Tissue Mill - Vents <MDL calculated at the detected mass
  - 8% of total facility emissions
  - 60% of modeled concentration impact

Impact of MDL Handling

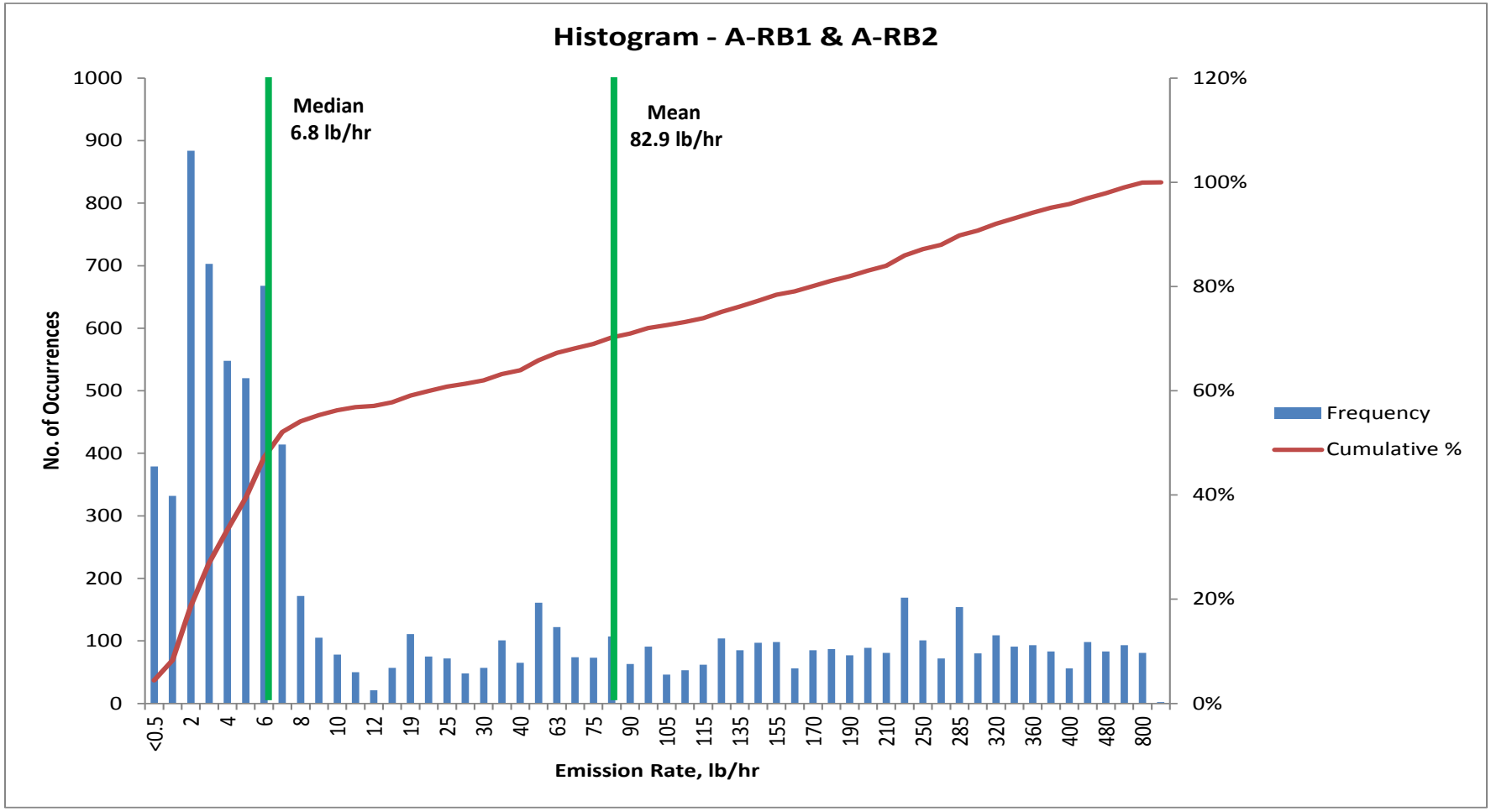


- Huge swings in $PM_{2.5}$ emissions depending on how data <MDL are treated
  - incremental annual $PM_{2.5}$ concentration impact ranges from 1 to 18 $\mu g/m^3$
  - magnitude of the swing (uncertainty) is > than the current annual standard in some cases
- 2011 EPA Guidance suggests use of data below MDL for regulatory purposes is inappropriate.

Impacts of Emissions Variability and Intermittent Operation on Modeled Impacts

- Emissions Variability
  - Emission rates for continuous sources are presently modeled at the "maximum allowable" (i.e., permitted) level to assess compliance with NAAQS.
  - Emission rate frequency distributions for various types of sources can be developed using CEMS data or based on emission factors and applying the variability of operating parameters.
- Intermittent Operation
  - NO_2 and SO_2 hourly guidance addresses for some cases. Same case can be made for $PM_{2.5}$.

Emissions Variability



- Permitted value is 810 lb/hr (3-hour average)
- Maximum hourly rate is 1.5x the 99th percentile, 99th percentile is 1.5x the 95th percentile
- Modeling at permitted value overstates the annual Mean by >1000%.

Conclusions

- One cannot ignore the uncertainty associated with emissions data being used as model inputs
  - Data treatment methods can drive modeled ambient impacts
- Recommendations
  - The update to Appendix W should include guidance on the selection and treatment of emissions data.
  - Provide modelers and regulators flexibility in handling of emissions data with
    - measurements close to or below MDL
    - high variability or intermittent operation
  - Given past EPA guidance, emission measurements <MDL would be excluded from modeling applications.