Ambient Air Modeling vs. Monitoring for $PM_{2.5}$

Jeff Bennett – Barr Engineering

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REGFORM
REGULATORY ENVIRONMENTAL GROUP FOR MISSOURI

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Presentation Summary

- Air quality modeling for permits
- $PM_{2.5}$ modeling challenges
  - Stringent air quality standards including increment
  - Conservative estimates of $PM_{2.5}$ primary emissions
  - $PM_{2.5}$ secondary formation analysis conservatism
  - Fire-related $PM_{2.5}$ high concentration events contributing to higher background
- Regulatory options
  - Reduce background concentrations
  - Monitoring
    - Model performance evaluations
    - Confirmation of air quality compliance
  - State modeling not required for primary emissions

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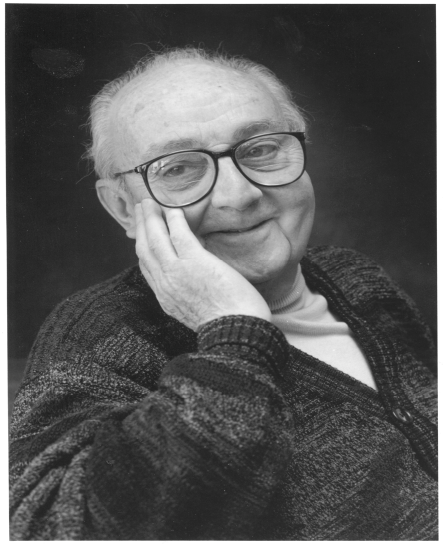
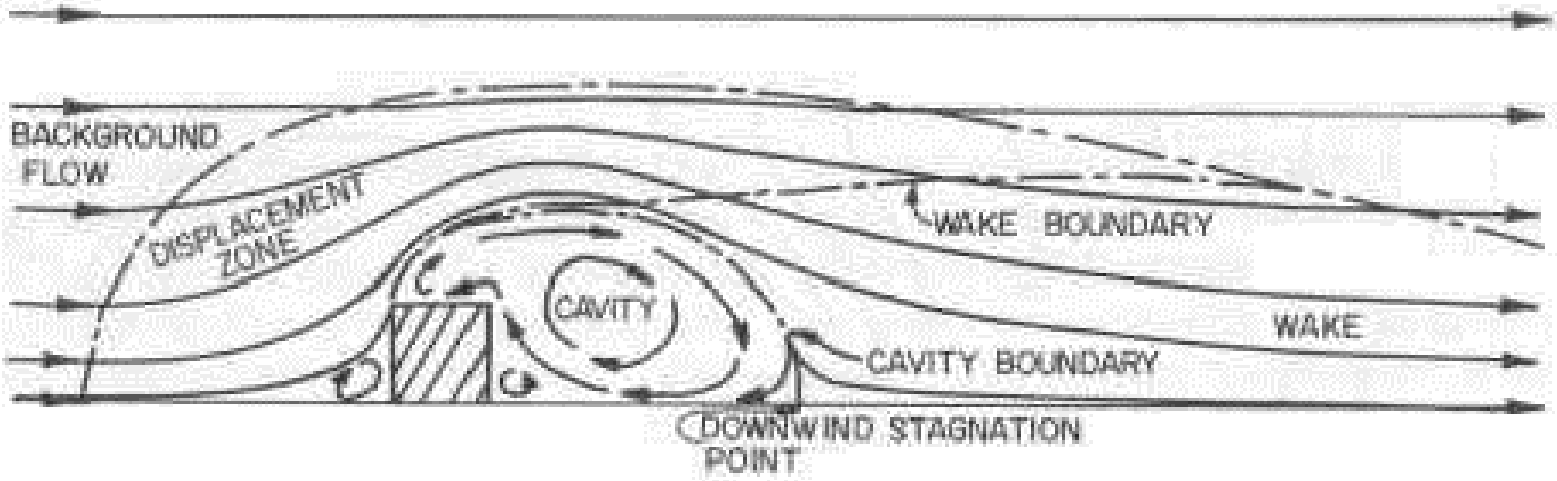
Models and air quality modeling for regulatory analysis

- George E.P. Box – 1987
  - *Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful.*





- Air quality models are designed to be conservative
  - Still need to predict reasonable concentrations

Current $PM_{2.5}$ air quality standards

Standard	24-hour	Annual
NAAQS	35 µg/m^3	12 µg/m^3
Increment	9 µg/m^3	4 µg/m^3
Significant Impact Level	1.2 µg/m^3	0.2 or 0.3 µg/m^3

- NAAQS
  - Average of 98th percentile 24-hour concentrations
  - Average of annual concentrations
- Increment
  - 2nd highest 24-hour concentration for each year
  - Annual concentration for each year
- Significant Impact Level
  - Average of maximum 24-hour concentrations
  - Average of annual concentrations

$PM_{2.5}$ modeling challenges

- Lowering air quality standards puts more pressure on pre-construction modeling
  - $PM_{2.5}$ Annual NAAQS
    - EPA mandated standards review

      12 µg/m^3 (2012 and 2020)
    - 2020 policy assessment suggested 8-12 µg/m^3, but concluded that "important uncertainties in the evidence" exist to prevent lower the NAAQS

- No guarantee, but new Administration may...

On-going $PM_{2.5}$ modeling challenges

- Conservative estimates of $PM_{2.5}$ primary emissions continue to make it difficult to pass air quality analysis
  - Including mechanically generated emission sources like rock crushing, transfers, and haul roads
  - Stack testing for combustion sources also have shown conservatism of AP-42 emission factors

On-going $PM_{2.5}$ modeling challenges

- $PM_{2.5}$ secondary formation analysis is required for PSD permits
  - Presumed impacts from project NOx and SO_2 emissions
- "Impacts" from secondary emissions are calculated using Modeled Emission Rates for Precursors (MERPs) – conservative screening approach
- Limited recognition by EPA and states that the maximum primary and secondary impacts do not overlap
  - Secondary PM conversion takes time and maximum primary impacts are nearly always very close to the sources

On-going $PM_{2.5}$ modeling challenges

- Elevated $PM_{2.5}$ concentrations are driven by regional influences with specific impacts from wildfires or prescribed burning activities
  - Contribute to high background concentrations

Flint Hills

What about possible options when a facility has to model $PM_{2.5}$?

- Enough challenges…
- What about any options or good news?

EPA policy change can make a difference in modeling analyses

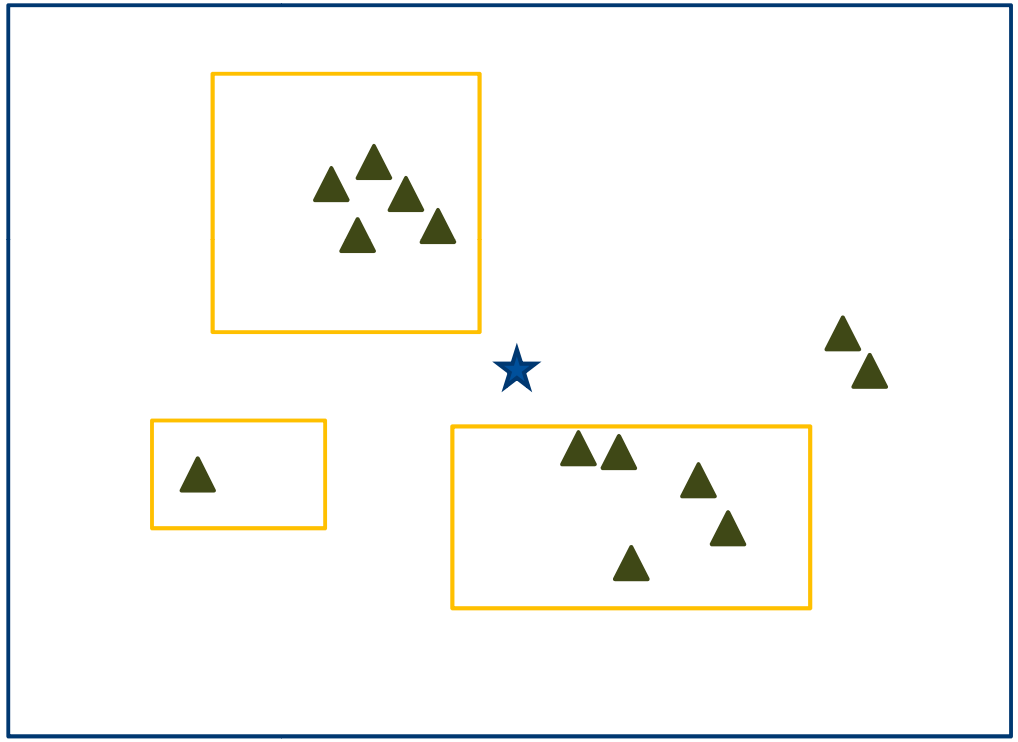
- Additional Methods, Determinations, and Analyses to Modify Air Quality Data Beyond Exceptional Events – April 4, 2019

- Exclusion of high concentration days from wildfires and other events have helped several clients to lower background monitored concentrations

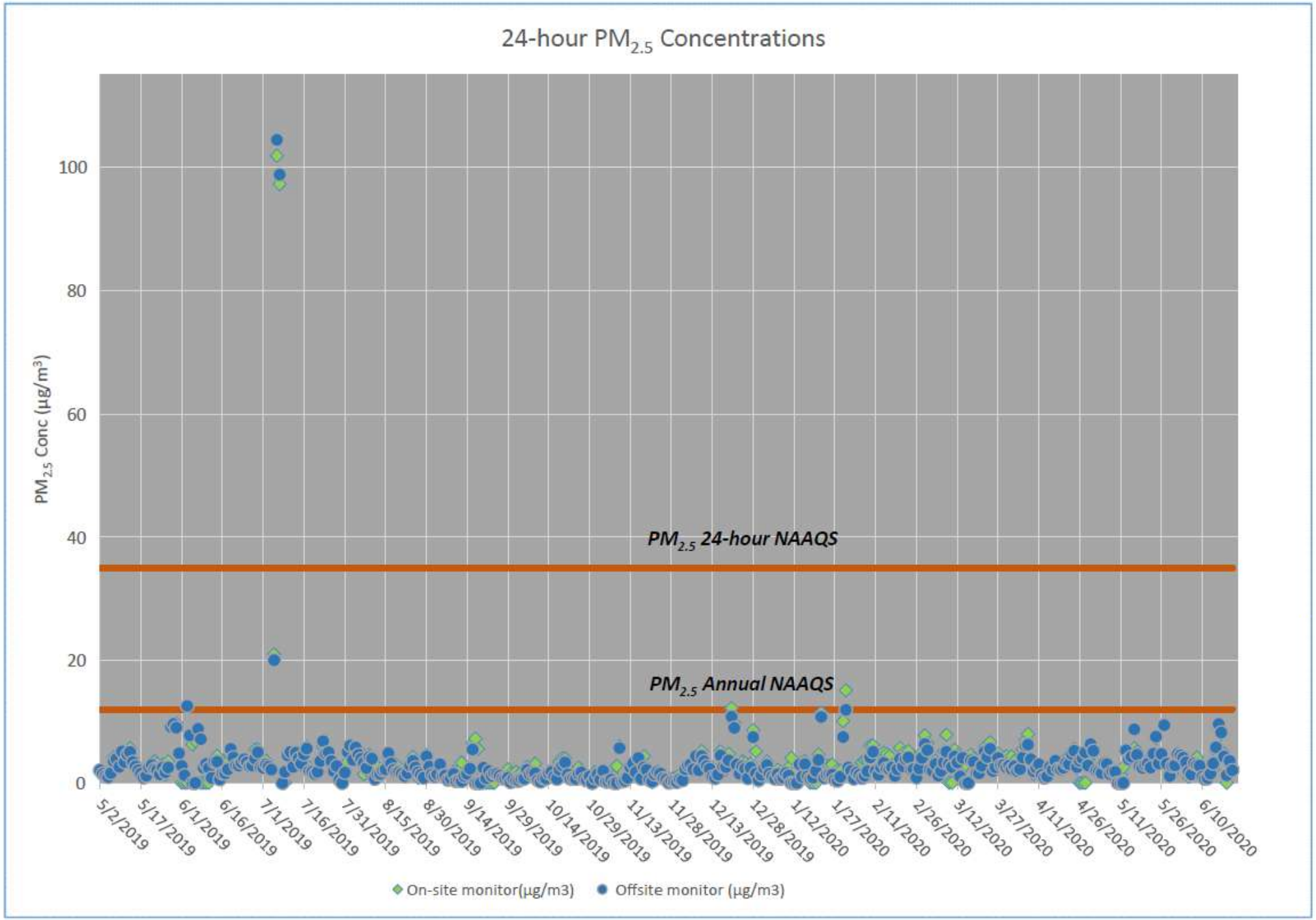
Monitoring $PM_{2.5}$

- Monitoring of $PM_{2.5}$ has been approved in certain circumstances to allow facilities to determine that modeling concentrations are unrealistically conservative
  - Stand alone demonstration using monitoring data
  - Actual emission modeling vs. monitor comparison
    - aka – Model performance evaluation
- Barr client in the Midwest has collected over 18 months of $PM_{2.5}$ monitoring data
  - Monitoring collected on-property and off-property

Facility Layout in Monitoring Example



Buildings
Ambient Boundary
Monitors
Stacks


24-hour PM2.5 Concentrations
PM2.5 Conc (µg/m3)
100
80
60
40
20
0
PM2.5 24-hour NAAQS
PM2.5 Annual NAAQS
5/2/2019
5/17/2019
6/1/2019
6/16/2019
7/1/2019
7/16/2019
7/31/2019
8/15/2019
8/30/2019
9/14/2019
9/29/2019
10/14/2019
10/29/2019
11/13/2019
11/28/2019
12/13/2019
12/28/2019
1/12/2020
1/27/2020
2/11/2020
2/26/2020
3/12/2020
3/27/2020
4/11/2020
4/26/2020
5/11/2020
5/26/2020
6/10/2020
On-site monitor(µg/m3)
Offsite monitor (µg/m3)

Monitoring $PM_{2.5}$

- Two high monitored days (>100 µg/m^3) were impacted by regional fires
- No real difference in on-site vs. off-site monitored concentrations
- Modeling for facility predicted >600 µg/m^3 maximum off-site impacts using allowable emissions (>100 µg/m^3 with actual emissions)
- Monitored 24-hour design value – 10 µg/m^3

- Facility is using a monitored demonstration instead of trying to perform an adjustment to the modeling (remember Professor Box)

Policy to eliminate state only modeling for $PM_{2.5}$

- As part of air modeling guidance, Wisconsin DNR issued a policy that $PM_{2.5}$ modeling was not required for state only analysis (non-PSD)

"This analysis shows that air quality dispersion modeling of an industrial source of direct emission of $PM_{2.5}$ does not provide information useful to understanding of the impact of the source on ambient air quality. The WDNR approach to determine whether a direct $PM_{2.5}$ source causes or exacerbates violation of an air standard or increment, and thus can be issued an air permit, will be consistent with the determination used for other regional pollutants such as ozone."

Summary

- $PM_{2.5}$ air quality standards may become more stringent
- Current modeling has many challenges
  - Conservative estimates of $PM_{2.5}$ primary emissions
  - $PM_{2.5}$ secondary formation analysis conservatism
  - Fire-related $PM_{2.5}$ high concentration events contributing to higher background
- Options
  - Use EPA policies to remove high background days
  - Carefully consider monitoring
  - Continue to evaluate air quality monitoring results to help convince other regulatory agencies that $PM_{2.5}$ modeling is unnecessary
- Best option is still to avoid air quality analysis

Questions

Jeff Bennett

Barr Engineering

jbennett@barr.com

(573) 638-5033