NO_2/SO_2 Modeling Issues Under the New 1-hour NAAQS

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Council of Industrial Boiler Owners
Arlington, VA
June 9, 2010

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Real Title – How Are We Supposed to Perform Dispersion Modeling Under the New 1-hour NAAQS?

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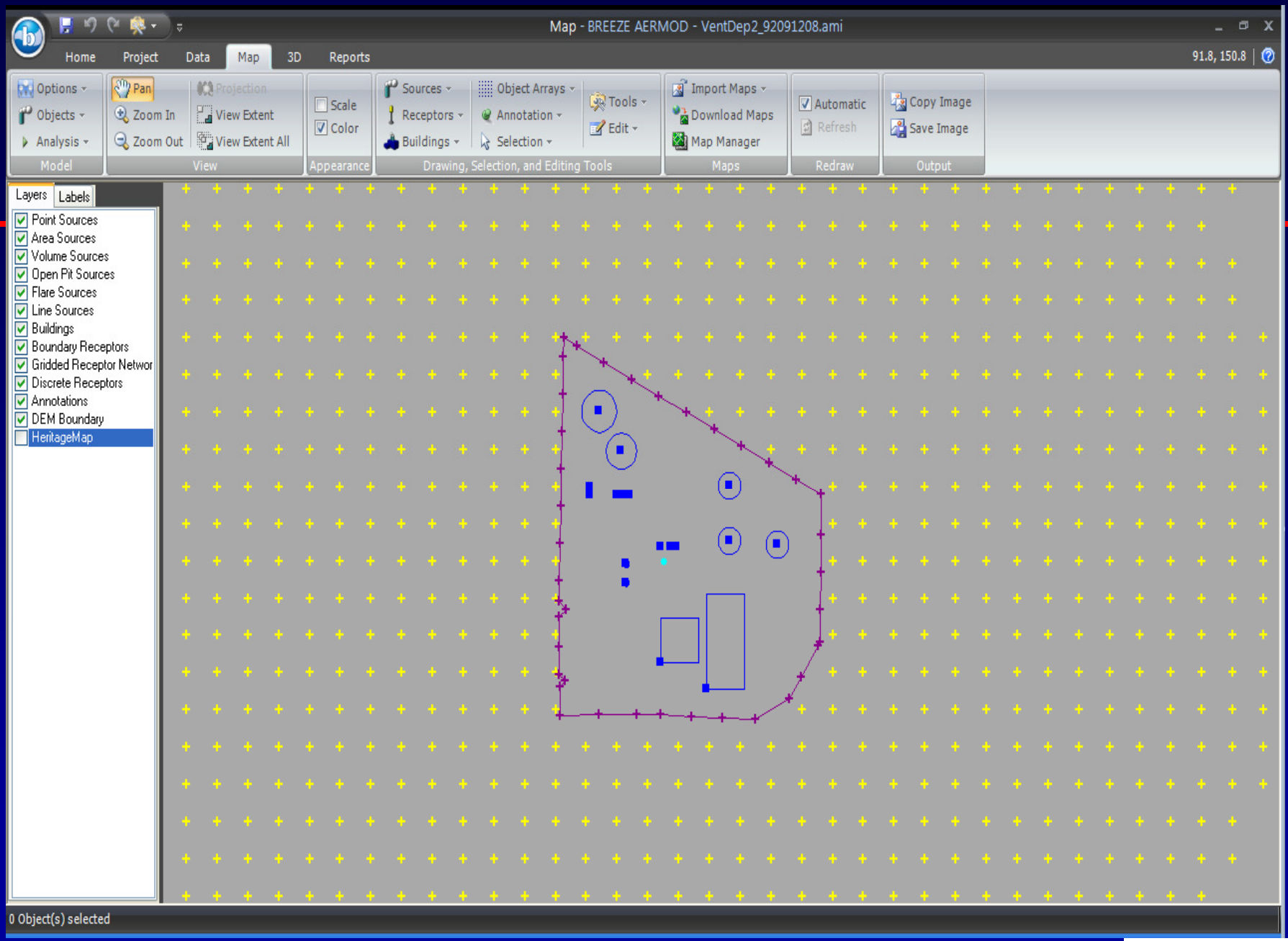
How Do We Choose a Modeling Methodology?

Federal & State Guidance

- Guideline On Air Quality Models
- New Source Review Workshop Manual
- State Guidance
- FLAG, FLM, VISTAS, MOG
- Support Center for Regulatory Air Models (SCRAM) and Clearinghouse

What is Ambient Air?

- Portion of the atmosphere, external to buildings, to which the general public has access [40 CFR Part 50.1 (e)] – where modeling is performed
- Attainment with standard demonstrated through dispersion modeling and ambient monitoring



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How Good Are the Models?

Guideline on Air Quality Models

- "Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at a specific location.
- The models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area.
- Errors in highest estimated concentrations of 10 to 40 percent are found to be typical. Estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable.
- Uncertainties do not indicate that an estimated concentration does not occur, only that the precise time and locations are in doubt."

What is Changing?

- NO_2 Ambient Standard
  - Added a 1-hour form of the standard to the existing annual standard
  - NO_2 standard is probabilistic
- SO_2 Standard
  - Added a 1-hour form of the standard
  - Revoked both annual and 24-hour standards
  - SO_2 standard is probabilistic

Potential and Real NO_2 Modeling Issues

- Probabilistic form of the 1-hr NAAQS
- All NOx emissions are not NO_2
- Atmospheric equilibrium ratios
- Using alternate NO_2 modeling methods
- Current and proposed regulatory requirements and modeling guidelines
- Challenges to NO_2 implementation

NO_2 NAAQS, Increments, SILs, SMC Background Information -

- Very low NO_2 NAAQS took effect 12 April 2010 - 100 ppb ~ 188 $\mu g/m^3$
- NO_2 PSD SILs – none established
- NO_2 PSD SMCs – none established
- NO_2 PSD increments – none established

What will local, state, and region environmental agencies use for compliance points?

What will industry use for compliance points?

Nitrogen Dioxide Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Nitrogen Dioxide	53 ppb	Annual	Same as Primary Standard	
	100 ppb	1-hour	Under Review with SO_2	

In January 2010, U.S. EPA:

- **Added a 1-hour primary NO_2 standard at a level of 100 ppb (effective April 12, 2010).**
- **Retained the annual primary standard of 53 ppb.**

The secondary NO_2 standards are currently being reviewed by the U.S. EPA as part of a joint review of the welfare effects associated with SO_2 and NO_2.

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NO_2 NAAQS

- Form of new 1-hour standard is the 3-yr average of the 98th percentile daily high 1-hour value for three consecutive years
  - For 365 highest 1-hour values this would be the 8th highest value each year
  - Average this value over a 3 year period
  - For modeling EPA allowing consideration of 5 year average, given a standard 5 year meteorological data set
- Difficult to model with existing models

Example: NO_2 modeling results

EXAMPLE: ONE YEAR, SINGLE RECEPTOR (8760 concentrations)											
1	3.25	**8.36**	2.94	0.63	**9.00**	…	0.00	6.58	6.90	2.29	0.40
2	2.62	1.12	6.45	4.28	2.73	…	3.92	6.92	5.61	3.50	0.83
3	0.93	7.25	4.61	**9.02**	**8.84**	…	1.74	7.65	1.02	**8.66**	3.70
.	.	.	.	.	.	.	.	.	.	.	.
22	6.56	4.91	1.34	1.32	1.45	…	**8.68**	0.45	2.49	2.04	6.15
23	1.96	**9.01**	2.18	5.53	5.22	…	3.41	3.84	1.30	1.63	**9.65**
24	2.86	1.48	3.56	5.02	5.58	…	4.94	**8.38**	2.70	**7.95**	1.55
HR/ DAY	1	2	3	4	5	…	361	362	363	364	365

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Example NO_2 modeling results, sorted

EXAMPLE: ONE YEAR, SINGLE RECEPTOR, SORTED (8760 concentrations)											
=MAX	**6.56**	**9.01**	**6.45**	**9.02**	**9.00**	**...**	**8.68**	**8.38**	**6.90**	**8.66**	**9.65**
	3.25	**8.36**	4.61	5.53	**8.84**	...	4.94	**7.65**	5.61	**7.95**	6.15
	2.86	**7.25**	3.56	5.02	5.58	...	3.92	**6.92**	2.70	3.50	3.70
	.	.	.	.	.	.	.	.	.	.	.	.
					.	.					
	2.62	4.91	2.94	4.28	5.22	...	3.41	6.58	2.49	2.29	1.55
	1.96	1.48	2.18	1.32	2.73	...	1.74	3.84	1.30	2.04	0.83
=MIN	0.93	1.12	1.34	0.63	1.45	...	0.00	0.45	1.02	1.63	0.40
HR/ DAY	1	2	3	4	5	...	361	362	363	364	365

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Example: 98th %ile of Daily Max

EXAMPLE: ONE YEAR, SINGLE RECEPTOR, SORTED (876 concentrations)											
=MAX	**6.56**	**9.01**	**6.45**	**9.02**	**9.00**	…	**8.68**	**8.38**	**6.90**	**8.66**	**9**
	3.25	**8.36**	4.61	5.53	**8.84**	…	4.94	**7.65**	5.61	**7.95**	6
	2.86	**7.25**	3.56	5.02	5.58	…	3.92	**6.92**	2.70	3.5	3
	.	.	.	.	.	.	.	.	.		
			.	.	.	.	.				
	2.62	4.91	2.94	4.28	5.22	…	3.41	6.58	2.49	2.29	1
	1.96	1.48	2.18	1.32	2.73	…	1.74	3.84	1.30	2.04	0
=MIN	0.93	1.12	1.34	0.63	1.45	…	0.00	0.45	1.02	1.63	0
HR/DAY	1	2	3	4	5	…	361	362	363	364	365

Daily Max	
9.65	=MAX(A1:A365)
9.02	
9.01	
9.00	
8.68	
8.66	
8.38	
6.90	98th %tile (H8H)
6.56	
6.45	

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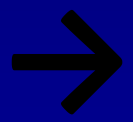
H8H: Shortcut to Daily Max?

Highest 8th high



Max	
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6.56	
6.45	

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Other NO_2 Modeling Issues

- Conservative: full NO_x to NO_2 conversion
- Address conversion of NO_x to NO_2 via Tier 2 and 3 modeling in Guideline on Air Quality Models
- Other sources in the area
- Background concentration representativeness
- Source cause & contribute analysis

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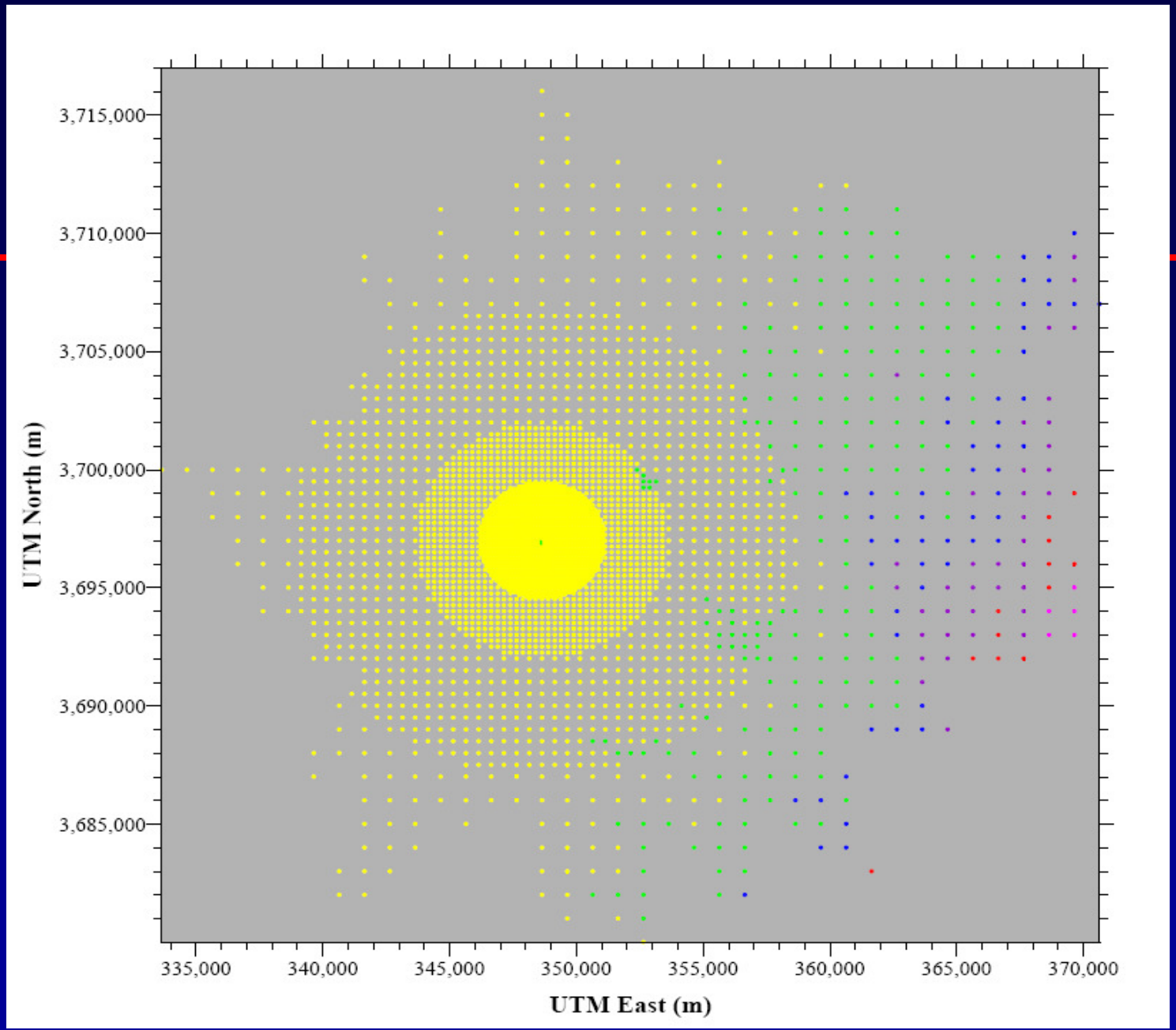

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Tier 3 Modeling - PVMRM

- Plume Volume Molar Ratio Method
- Case by case assessment until clearer guidance from EPA
- Three variables to input
  - In stack NO_2/NOx ratio
  - Equilibrium ratio downwind
  - Background ozone
- Lower concentrations

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NO_2 SIL Analysis

- No SIL –
  - how establish if significant impact or not?
  - how establish area of impact (SIA)?
  - how pick other regional sources for modeling?
  - what to do if large regional impacts?
- How to evaluate this standard for a new or modified source?
- States are applying their own SILs

NO_2 Increment Analysis

- How set baseline date?
- How determine NO_2 increment consumers?
- How to determine background concentrations?

NO_2 Guidance

- USEPA Guidance indicates that if five years of modeling data is being used the following steps should be taken
  - Generate an hourly POSTFILE with AERMOD for each year modeled (Depending on the number of receptors, this could be file in the hundreds of megabytes to gigabytes)
  - Determine the peak hourly value for each day of the year for each receptor
  - Find the eighth highest peak daily value each year at each receptor
  - Average these values across the five years modeled
  - USEPA to issue tool to perform this analysis in the "near future"
- No clear guidance yet on how to proceed if using one year of on site meteorological data

SO_2 NAAQS

- USEPA has proposed a one hour Primary SO_2 Standard
  - Final action was June 2, 2010
  - Revised standard was 75ppb (196 $\mu g/m^3$) at the 99th percentile averaged over three years based on the daily high 1-hr value
- USEPA has not proposed any guidance on how to analyze this new standard in permitting as part of this rulemaking

SO_2 NAAQS

- Analysis of this standard, if promulgated, would be similar to the one-hour NO_2 standard
  - 4th high one-hour daily high value would be used in the analysis instead of the 8th high one-hour daily high value - 99th percentile
- New standard could affect any source that emits SO_2 in significant amounts regardless of fuel
- EPA plans to use modeling to discern contributing sources and attainment status

So What to Ask of EPA?

- Promulgate reasonable SO_2 and NO_2 SILs
- Provide appropriate modeling tools
- Modify existing or develop a new near field dispersion model
- Use monitors only, but some will be roadside
- Delete hours when model performance is questionable
- Use of probabilistic emissions, operations

Who Are the Modeling Regulators?

- Federal
  - Tyler Fox, OAQPS, RTP
  - Roger Brode, OAQPS, RTP
  - Stephen Page, Director, OAQPS, RTP
  - Regional meteorologists
- State
  - State modelers and meteorologists
- Local Agencies - All understaffed

Summary

- New short-term NAAQS are difficult to model with current tools
- Guidance is sparse and behind
- Models will likely give high impacts
- Uncertainties in models make them less credible for short-term estimates
- More guidance forthcoming soon?

Discussion??

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