

# Slogging Through the Modeling Maze: New National Ambient Air Quality Standards for NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>2.5</sub>

Speakers:

Leland Villalvazo, San Joaquin Valley Air Pollution Control District

Patrick Sullivan, SCS Engineers

Gary Rubenstein, Sierra Research

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MOTHER LODGE CHAPTER

# Slogging Through the Modeling Maze

- Overview of the new standards
- Modeling guidance documents
- Modeling challenges
- Case studies
- Conclusions

# Overview of the New Standards

- 1-hour  $\text{NO}_2$
- 1-hour  $\text{SO}_2$
- 24-hour  $\text{PM}_{2.5}$

# Overview of the New Standards

## 1-hour NO<sub>2</sub>

- 100 ppb (188 µg/m<sup>3</sup>), based on the three-year average of the 98<sup>th</sup> percentile of the daily 1-hour maxima, not to be exceeded
  - Determine the daily 1-hour maximum for each day of the year for three years (365 values/year for 3 years)
  - Determine the 98<sup>th</sup> percentile of these maxima for each of the three years (three values)
  - Average the three 98<sup>th</sup> percentile values (1 value)
- Current California standard is 180 ppb (339 µg/m<sup>3</sup>), not to be exceeded

# Overview of the New Standards

## 1-hour SO<sub>2</sub>

- 75 ppb (196 µg/m<sup>3</sup>), based on the three-year average of the 99<sup>th</sup> percentile of the daily 1-hour maxima, not to be exceeded
  - Determine the daily 1-hour maximum for each day of the year for three years (365 values/year for 3 years)
  - Determine the 99<sup>th</sup> percentile of these maxima for each of the three years (three values)
  - Average the three 99<sup>th</sup> percentile values (1 value)
- Current California standard is 250 ppb (655 µg/m<sup>3</sup>), not to be exceeded

# Overview of the New Standards

## 24-hour PM<sub>2.5</sub>

- 35 µg/m<sup>3</sup>, based on the three-year average of the 98<sup>th</sup> percentile of the 24-hour averages, not to be exceeded
  - Determine the daily 24-hour average for each day of the year for three years (365 values/year for 3 years)
  - Determine the 98<sup>th</sup> percentile of these maxima for each of the three years (three values)
  - Average the three 98<sup>th</sup> percentile values (1 value)
- There is no California 24-hour average standard for PM<sub>2.5</sub>

# Modeling Guidance Documents - EPA

- PSD implementation of 1-hr NO<sub>2</sub> NAAQS , 1-hr NO<sub>2</sub> SIL and tie to 40 CFR Part 51 Appendix W
  - <http://www.epa.gov/nsr/documents/20100629no2guidance.pdf>
- PSD implementation of 1-hr SO<sub>2</sub> NAAQS , 1-hr SO<sub>2</sub> SIL and tie to 40 CFR Part 51 Appendix W
  - <http://www.epa.gov/region07/air/nsr/nsrmemos/appwso2.pdf>
- 24-hr PM<sub>2.5</sub> NAAQS modeled attainment test and modeling procedures
  - [http://www.epa.gov/ttn/scram/guidance/guide/Update to the 24-hour PM25 Modeled Attainment Test.pdf](http://www.epa.gov/ttn/scram/guidance/guide/Update%20to%20the%2024-hour%20PM25%20Modeled%20Attainment%20Test.pdf)
  - <http://www.epa.gov/scram001/Official%20Signed%20Modeling%20Proc%20for%20Demo%20Compli%20w%20PM2.5.pdf>

# Modeling Guidance Documents - CAPCOA

- CAPCOA 1-Hour NO<sub>2</sub> Modeling Guidance

[http://www.valleyair.org/busind/pto/Tox\\_Resources/CAPCOANO2GuidanceDocument10-27-11.pdf](http://www.valleyair.org/busind/pto/Tox_Resources/CAPCOANO2GuidanceDocument10-27-11.pdf)

# Modeling Guidance Documents - Others

- San Joaquin Valley APCD Guidance
  - Modeling Guidance
  - Intermittent Operating Units
  - Draft PM<sub>2.5</sub> Modeling Procedures
  - 1-Hour SO<sub>2</sub> Modeling Protocol

[http://www.valleyair.org/busind/pto/Tox\\_Resources/AirQualityMonitoring.htm](http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm)

# Modeling Challenges

- Stringency of the standards
- Assembling met data/background AQ data (including concurrent ozone data for ozone limiting)
- Combining background and project data
- Cumulative impacts/modeling other sources (Q/D approximations)
- Inconsistencies in guidance
- Computing resource requirements

# Combining Background and Project Data 1-hour NO<sub>2</sub> - 11 Options!

1. Significant Impact Level (SIL) – no background required
2. Max modeled value + max monitored value
3. Max modeled value + 98<sup>th</sup> pctl monitored value
4. 8<sup>th</sup> highest modeled value + max monitored value
5. 8<sup>th</sup> highest modeled value + 98<sup>th</sup> pctl monitored value
6. (5 yr avg of 98<sup>th</sup> pctl modeled value) + max monitored value
7. (5 yr avg of 98<sup>th</sup> pctl of modeled value) + 98<sup>th</sup> pctl monitored value
8. 5 yr avg of 98<sup>th</sup> pctl of (modeled value + monthly hour-of-day – 1<sup>st</sup> high)
9. 5 yr avg of 98<sup>th</sup> pctl of (modeled value + seasonal hour-of-day – 3<sup>rd</sup> high)
10. 5 yr average of 98<sup>th</sup> pctl of (modeled value + annual hour-of-day - 8<sup>th</sup> high)
11. Paired-Sum: 5 yr avg of 98<sup>th</sup> pctl of (modeled value + background)

## Sources:

[http://www.valleyair.org/busind/pto/Tox\\_Resources/CAPCOANO2GuidanceDocument10-27-11.pdf](http://www.valleyair.org/busind/pto/Tox_Resources/CAPCOANO2GuidanceDocument10-27-11.pdf)

[http://www.epa.gov/ttn/scram/Additional\\_Clarifications\\_AppendixW\\_Hourly-NO2-](http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-)

[NAAQS\\_FINAL\\_03-01-2011.pdf](http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf)

# Case Studies

- LFG to energy projects
- Emergency generators
- Power generation/large NO<sub>x</sub> sources in urban areas

# Case Study – Landfill/LFG Projects

- Gensets
  - Engines or Turbines
- Landfill Sources
  - Diesel/Gasoline Engines
    - Tippers, back-up generator, grinder, etc.
  - Flares (LFG)
  - Fugitive
    - Roads & Stockpiles
- Nearby Sources
  - Obtain inventories from agencies



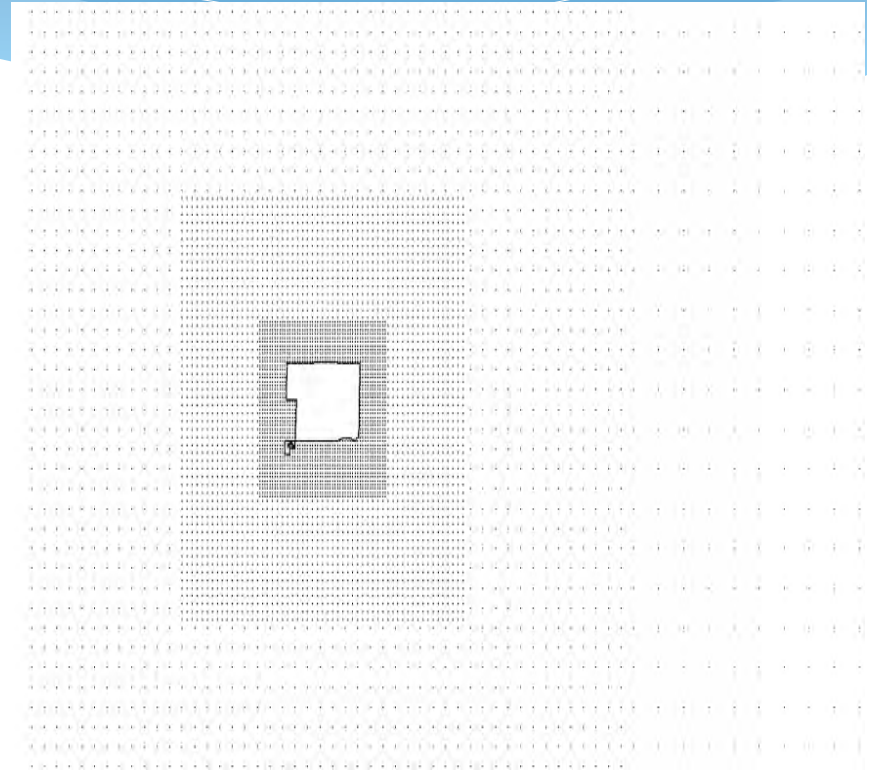
# Challenges

- Complex Terrain
  - Canyon Landfills
    - Plume impacts nearby receptors
    - Channeling of winds
- Gensets near Boundary
  - Stable Geology
    - Center of LF for trash
  - Close to offsite receptors
  - High downwash concentrations at fenceline receptors
- Remote
  - Few nearby met stations
  - Few nearby background AQ monitors
- Fugitive sources with ground level releases



# Challenges (cont.)

- Landfills are large
  - Numerous receptors are needed
- New 1-hour  $\text{NO}_2$  and  $\text{SO}_2$  NAAQS
  - Difficult to meet
  - Large Significant Impact Area (SIA)
  - Form of NAAQS (percentile) different and more complex than other standards
- Large emissions sources sometimes nearby



# Solutions to Pass Modeling

- Move plant to higher elevation
- Raise stack heights
- Increase release velocity
- Use a common chimney
  - Increases buoyancy
- Reduce building height
  - Remove parapet wall
  - Use genset “containers”
- Align stacks crosswind
  - Provides initial dispersion
- Change project



# Ideas for Modeling Efficiency

- Contribution Analysis
  - Verify project sources not significant when nearby sources cause violations
- Invoke “Fastall”
  - Non regulatory AERMOD option to reduce runtime
  - Use regulatory option for agency submittal
- Partition runs
  - Use multiple processors
  - Recombine results in post-processor

# Case Studies

- Bay Area Landfill: Failure of 1-Hour NO<sub>x</sub> Standard
  - Small Airport Met Data: numerous calms
  - Startup hour emissions: inflated maximum
  - Met Data produced worst-case results for 98<sup>th</sup> percentile
  - Number of LFG engines had to be reduced, affecting economics of project
  - Stack orientation and height changed

# Case Studies (cont.)

- Oregon Landfill: Failure of 1-Hour SO<sub>x</sub> Standard
  - High sulfur in landfill gas produced high SO<sub>x</sub> emissions
  - Maximum hourly emissions: based on max. sulfur content
  - Competing sources also with high SO<sub>x</sub> emissions
  - Installed on-site met station to avoid using screening met; cost and delay
  - Stack height changed; reduced building height
  - Accepted fuel sulfur limit; may be problematic

# Case Studies (cont.)

- Oregon Landfill: Failure of 24-Hour PM<sub>2.5</sub>
  - State PSD requires modeling of fugitives
  - Fugitive dust significant at landfills
  - Max. 24-hour emissions based on max. disposal rate
  - Haul roads and rail yard right at landfill boundary
  - Installed on-site met station to avoid using screening met; cost and delay
  - Paved roads and rail yard to reduce emissions (\$)
  - Divided into road segments; modeled as line sources

# Conclusions

- New analyses for NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>2.5</sub> are not for the faint of heart.
- Read and understand the applicable guidance before you start.
- Perform experimental runs early to determine hardware/resource requirements.

# Conclusions (cont'd)

- Identify data sources, prepare a detailed protocol, seek and obtain agency approval **BEFORE** you start your analysis.
- Repeat as often as necessary until permit is issued.