TCEQ CAMx/BART Modeling Analysis Overview: PM/VOC Zero-Out NO_x/SO_2 PSAT (DRAFT)

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TCEQ CAMx/BART Modeling

- Modeling conducted by Environ on behalf of TCEQ
- If sources choose to continue BART evaluation with CAMx, what resources are available?

TCEQ CAMx/BART Modeling

- Surveys of ~250 sources; sources determined to be potentially BART-eligible were included in CAMx Model runs
- Screening Modeling for VOC; all BART sources in Texas screened out for VOC
- Screening Modeling for PM; three (2 EGU and 1 NEGU) sources did not screen out
- PSAT screening for NOx and SO_2 for NEGU sources; 66 NEGU sources did not screen out

TCEQ CAMx/BART Modeling

Three Documents Available For Review:

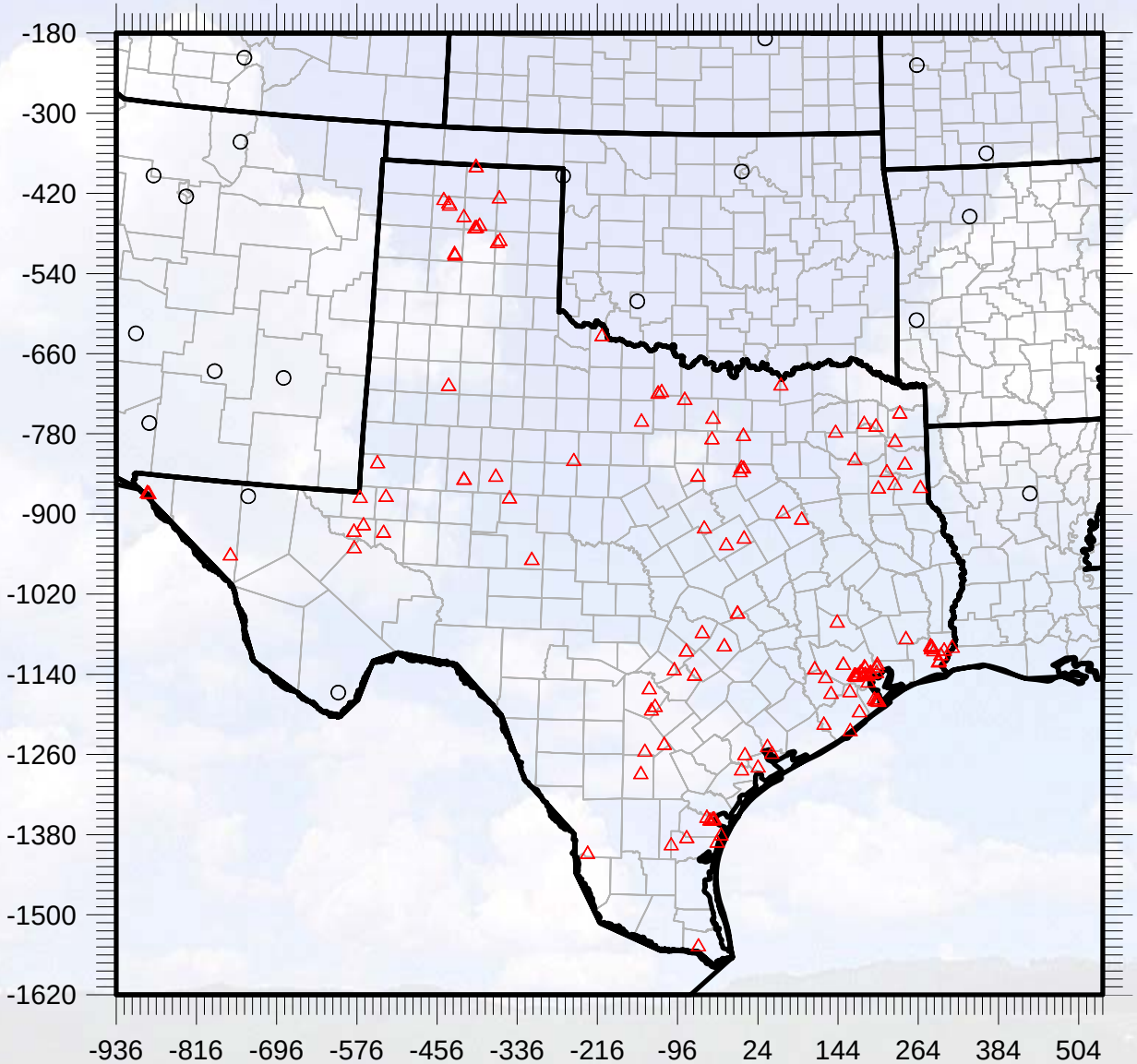
- *The Draft Final Modeling Protocol:*
  Screening Analysis of Potentially BART-Eligible Sources in Texas
- *Draft Final Report:* *Screening Analysis of Potential BART-Eligible Sources in Texas*
  +New Addendum that includes Texas Model Plant (currently under review)
- *Draft CAMx Modeling Guidance:* *Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas*

All documents can be found at:
http://www.tceq.state.tx.us/implementation/air/sip/bart/haze.html

TCEQ CAMx/BART Modeling

- Used CAMx to perform cumulative (multiple source) BART screening analysis
- Screening Analysis consists of 3 major run types:
  - PM/VOC zero-out
  - Inert PM
  - NO_x/SO_2 PM Source Apportionment

Location of Possible TX BART Sources (triangles) and IMPROVE monitors (circles) that include Class I areas



PM/VOC Zero-out Runs (1)

- Purpose
  - To identify potentially BART-eligible sources of PM and VOC that do not significantly impact visibility at nearby Class I areas
  - Identified sources will be exempt from further BART analysis for PM and VOC

PM/VOC Zero-out Runs (2)

- **Started with CenRAP 2002 36-km annual CAMx modeling database**
  - Added 12-km grid over Texas and surrounding areas
  - Run 1: 2002 Base Case with 24-hour maximum BART PM and VOC emissions
    - 24-hr max. emissions were estimated by doubling annualized average emissions
  - Run 2: Zero out Texas BART PM and VOC emissions
  - Run as 4 quarters with 15-day spin-up

PM/VOC Zero-out Runs (3)

- **Calculate visibility impacts due to differences in concentrations predicted at Class I areas in the Base Case and Zero-out runs**
  - Process results at each Class I area to get incremental extinction due to doubled BART sources' emissions
  - Convert results to deciview (dv) using EPA default natural conditions for three levels:
    - Best 20% Days, Worst 20% Days and Annual Average

PM/VOC Results

- VOC shown not to have significant visibility impact.
- PM emissions, however, need further analysis.

PM Inert Runs

- Since only primary PM emissions were being considered in these runs, chemistry was not needed.
- Primary PM emissions were analyzed using inert CAMx simulations of the grouped BART sources. The procedures for evaluating the visibility impacts from the inert CAMx simulations are the same as described for the PM impacts from the zero-out runs.
- However, instead of using concentrations differences from the 2002 BART base case and 2002 zero-out case, the total concentrations due to all BART sources in each BART group from the CAMx inert simulation were used.

Current IMPROVE Equation

Calculate extinction using IMPROVE Reconstructed Mass Extinction Equation:

$b_{Sulfate} = 3 \times f(RH) \times [SO_4]$

$b_{Nitrate} = 3 \times f(RH) \times [NO_3]$

$b_{EC} = 10 \times [EC]$

$b_{OM} = 4 \times [OM]$

$b_{Soil} = 1 \times [Soil]$

$b_{CM} = 0.6 \times [CM]$

Monthly and Class I area-specific RH adjustment factors [f(RH)] are used

Total extinction due to source:

$$b_{source} = b_{Sulfate} + b_{Nitrate} + b_{EC} + b_{OM} + b_{Soil} + b_{CM}$$

Visibility Calculations

Calculate Haze Index for the source in deciview:

$$\text{Haze Index} = HI_{source} = 10 \ln(b_{source} + b_{natural})/10$$

Calculate change in deciview due to the source:

$$\begin{aligned} \text{delta-dv} &= HI_{source} - HI_{natural} \\ &= 10 \ln[(b_{source} + b_{natural})/10] - 10 \ln[b_{natural}/10] \\ &= 10 \ln[(b_{source} + b_{natural})/b_{natural}] \end{aligned}$$

NO_x/SO_2 PSAT Run (1)

- PSAT = PM Source Apportionment Technology in CAMx
  - Apportions predicted PM concentrations at receptors to defined source groups
- Purpose:
  - Identify potentially BART-eligible NO_x and SO_2 sources which do not significantly impact visibility at nearby Class I areas
  - Identified sources will be exempt from further BART analysis for NO_x and SO_2

NO_x/SO_2 PSAT Run (2)

- **Start with CenRAP 2002 36-km annual CAMx modeling database**
  - Add 12-km grid over Texas and surrounding areas
  - CAMx PSAT
  - BART sources of NO_x and SO_2 emissions treated with Plume-in-Grid (PiG)
  - Divide BART sources into 10 source groups
    - 24-hr max. emissions were estimated by doubling annualized average emissions
    - Rank sources by Q/D and divide into deciles

Visibility Calculations

Calculate visibility impacts due to NO_3 and SO_4 using reconstructed mass extinction equation:

$$b_{group} = bNO_3 + bSO_4$$

Calculate Haze Index due to group of sources:

$$HI_{group} = 10 \ln[(b_{group} + b_{natural})/10]$$

Calculate change in dv due to group of sources:

$$\text{del-dv} = HI_{group} - HI_{natural}$$

$$= 10 \ln[(b_{group} + b_{natural})/10] - 10 \ln[b_{natural}/10]$$

$$= 10 \ln[(b_{group} + b_{natural})/b_{natural}]$$

PM/VOC Results

- All primary PM and VOC emissions together did not screen out
- Reanalyzed the data for just VOC; all VOC screened out
- Broke up PM into smaller source groups and reran model (3 more rounds of PM modeling); 3 sources did not screen out

PSAT Results

- In the initial round of PSAT modeling, none of the groups screened out
- Took groups 5 through 9 and broke them down into deciles for a second round of PSAT runs
- Two source groups screened out
  - (Groups 1 and 5)
- 66 remaining NEGUs did not screen out

CAMx Guideline Document (1)

- Describes the existing modeling setup
- Version of CAMx (just released 4.40)
  - Enhancements to PM Source Apportionment Technology
  - Updates to the PSAT Formulation and New Full-Science Chemistry PiG
- Procedures for screening BART source VOC and PM emissions using zero-out and inert modeling

CAMx Guideline Document (2)

- Procedures for screening BART source NO_x and SO_2 emissions using PSAT and PiG
- Computational requirements
- Example runs scripts

Questions?

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