

MODIFIED BART ANALYSIS METHODOLOGY FOR THE REGIONAL HAZE RULE

Neelesh V Sule, PhD, PE - Senior Consultant | Christine Chambers - Principal Consultant | Jeremy Jewell, CM - Principal Consultant
16th Annual CMAS Conference, Chapel Hill, NC, October 23-25, 2017

INTRODUCTION

The Regional Haze Rule (RHR) established a comprehensive visibility protection program for Class I areas and requires States to set reasonable progress goals (RPGs) towards achieving natural visibility conditions for Class I areas within their borders. States must evaluate emissions controls through Best Available Retrofit Technology (BART) determinations and Reasonable Progress (RP) analyses for stationary sources emitting air pollutants that cause or contribute to visibility impairment in a Class I area. RPGs are intended to be used for comparison between a state's long-term strategy and the uniform rate of progress (URP) curve, while providing a target by which a state's Regional Haze State Implementation Plan (SIP) can be assessed for adequacy. For RP and recent BART analyses, the Comprehensive Air Quality Model with Extensions (CAMx) modeling system can be used to assess Class I area visibility impacts from individual sources coupled with the cumulative visibility impact of all other emissions sources including naturally occurring events and international emissions. CAMx is a rigorous modeling system that can reliably predict visibility impacts, and that prediction reliability is improved through correlating the modeled data with available monitored data.

OBJECTIVE

On January 4, 2017, the Environmental Protection Agency (EPA) published a proposed Federal Implementation Plan (FIP) to address the best available retrofit technology (BART) requirements for electric generating units (EGU) in Texas (Proposed FIP).¹ The post-processing methodology used by EPA in the Texas FIP BART analyses focused on finding the absolute highest modeled impact without tethering the modeled results with monitored data. The primary objective of this study was to develop a robust and technically defensible post-processing methodology for estimating visibility impacts. With Trinity's post processing methodology, the CAMx modeled output is tethered with monitored data to provide robust results that compensate for the potential model bias issues that the current BART methodology fails to address.

METHODOLOGY

The raw CAMx output files from EPA's baseline modeling scenario was analyzed using the revised post-processing methodology including the hourly overall average concentration files and the source apportionment concentration files, for all modeled dates and for each grid utilized (i.e., 12-km and 36-km grids). The revised post-processing methodology uses the following approach for estimating visibility impacts from individual sources:



Extract Hourly Concentrations

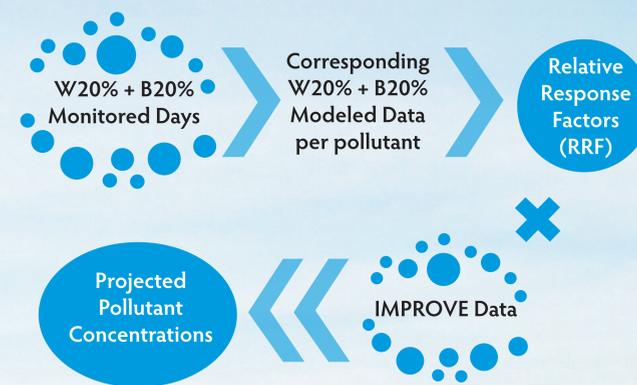
XstatX, a post-processing utility program, was first used to extract the hourly modeled concentrations at each grid cell for all 365 modeled days from the CAMx output average concentration files for both the 36-km and 12-km grids. Similarly, the hourly modeled concentrations sources were also extracted from the source apportionment files and were multiplied by a factor of negative one. These now-negative individual source concentrations were then merged with the overall average baseline concentrations so as to create individual "zero-out" concentration files for each of the sources (i.e., these files represent the average baseline concentrations minus the concentrations attributable to each source).

Calculate 24-hour Average Concentrations for Each Pollutant

The camx2mats utility was next used to calculate 24-hour average concentrations for each pollutant and grid cell based on the XstatX output. The resulting intermediate output files were comma-separated-value (CSV) files ready for input into MATS, which requires 24-hour average speciated concentrations at each modeled grid cell. In this case, MATS-ready files were created based on the overall average baseline concentrations as well as the "zero-out" concentrations from each source.

Use the Modeled Attainment Test Software (MATS) to Calculate Relative Response Factors (RRF)

The primary files required to run MATS as part this evaluation included the overall average baseline CSV file, the "zero-out" CSV files for each source, and IMPROVE monitoring data, which is provided in the MATS software package download.² Based on the 20 percent best and 20 percent worst monitored visibility days in 2002 (baseline year) at each Class I area included in the modeled domain, MATS extracted the daily modeled concentration data corresponding to the 20 percent best and 20 percent worst visibility dates from the overall modeled concentration CSV files to calculate the average 20 percent best and 20 percent worst modeled concentrations of each of the pollutants identified (e.g., sulfates, nitrates, etc.) for each Class I area. The same averaging calculations were then performed using the same dates with the "zero-out" concentration CSV files.



Evaluate the Visibility Impacts

The RRFs obtained from MATS were next applied to 2002 IMPROVE data to project the "zero-out" concentrations for the sources. These projected concentrations were then input into the IMPROVE algorithm shown below to estimate the extinction attributable to each source.

$$b_{ext} = 2.2 \times f_s(RH) \times [Small\ Sulfate] + 4.8 \times f_s(RH) \times [Large\ Sulfate] + 2.4 \times f_s(RH) \times [Small\ Nitrate] + 5.1 \times f_s(RH) \times [Large\ Nitrate] + 2.8 \times [Small\ Organic\ Mass] + 6.1 \times [Large\ Organic\ Mass] + 10 \times [Elemental\ Carbon] + 1 \times [Fine\ Soil] + 1.7 \times f_{is}(RH) \times [Sea\ Salt] + 0.6 \times [Coarse\ Mass] + Rayleigh\ Scattering\ (Site\ Specific) + 0.33 \times [NO_2(ppb)]$$

$$Deciview\ Haze\ Index\ (dv) = 10 \times \ln \left(\frac{b_{ext} [Mm^{-1}]}{70 [Mm^{-1}]} \right)$$

Monitored concentrations of visibility impairing pollutants associated with the 20 percent worst visibility days were first obtained from 2002 IMPROVE data. These observed concentrations were then multiplied by the "zero-out" RRFs, resulting in projected "zero-out" concentrations for each of the 20 percent worst days. These concentrations were input into the IMPROVE algorithm to estimate the corresponding "zero-out" extinction (bext) which were then converted to the deciview haze index.

The resulting "zero-out" haze index values represent the overall daily monitored 2002 deciview haze index minus the approximate individual contributions of each source. The individual visibility impacts attributable to each source were then calculated for each of the 20 percent worst days as the difference between the overall daily monitored 2002 deciview haze index and the "zero-out" haze index value. The maximum daily individual unit impact from the 20 percent worst days was then calculated using the following equation.

$$Individual\ Unit\ Impact\ (dv) = Overall\ Haze\ Index\ (dv) - "Zero-Out"\ Haze\ Index\ (dv)$$

RESULTS

The revised post-processing methodology utilized in this assessment overcomes many of the fundamental problems with the methodology utilized in the Proposed FIP. Rather than relying on the absolute modeled concentrations, the use of RRFs to tether the modeling results to actual monitor data ameliorates potential concerns of model bias, especially when considering the questionable MPE results.

- Additionally, focusing on the 20 percent worst visibility days relates the impacts from sources to the standard metric used to represent visibility conditions in a Regional Haze Rule regulatory context—thus focusing on the days most in need of visibility improvement.
- Further, by not relying on the absolute maximum modeled impacts, the revised post-processing methodology minimizes the effects of modeled outlier values that can cause visibility impacts to be overstated.

Table 1 shows percent change in visibility estimated based on Trinity's proposed post-processing methodology as compared to the method used by EPA in the Proposed Texas BART FIP assessment.

Table 1: Maximum % Change in Daily Visibility Impacts on the 20 Percent Worst Visibility Days (Trinity Method)

Source Name	Class 1 Area	% Change in Maximum Visibility*
Source A	Wichita Mountains Wilderness (WIMO)	-99.5%
	Salt Creek Wilderness (SACR)	-94.2%

* Negative change indicates Trinity's proposed post-processing methodology estimated lower visibility impact than estimated by EPA's Proposed FIP.

REFERENCES

- ¹ Proposed Rule, Promulgation of Air Quality Implementation Plans; State of Texas; Regional Haze and Interstate Visibility Transport Federal Implementation Plan, 82 Fed. Reg. at 912 (Jan. 4, 2017).
- ² Environmental Protection Agency. Photochemical Modeling Tools – Modeled Attainment Test Software: https://www3.epa.gov/scram001/modelingapps_mats.htm