WRAP Dust Tools and Resources

CONCLUSION STATEMENT

The WRAP DEJF has supported several projects that provide data resources and/or tools to Regional Haze SIP developers and their technical staff. These projects include the Causes of Haze Assessment (COHA), the Causes of Dust (COD), the Fugitive Dust Handbook and Website, and the Analysis of Fine Particulate Matter in Fugitive Dust. The results and conclusions of these efforts include:

•The COHA and COD projects seek to identify key geographic source areas of emissions at each Class I area in the WRAP area, documents the assumptions and methods used, and provide succinct, clear summaries suitable for policy makers, of the estimated areas and sources of impairment for each Class I area, including the extent of uncertainty about the estimates.

•The Fugitive Dust Handbook and Website incorporate available information about dust emission estimation methods, control techniques, and fugitive dust compliance tools, into a comprehensive document that will be useful to all WRAP members when addressing specific air quality issues and when developing regional haze implementation plans.

•The Analysis of Fine Fraction of Particulate Matter in Fugitive Dust was motivated by a discrepancy in the proportion of fugitive dust found in PM-2.5 emission inventories as compared to the proportion on ambient filter samples. The results of this study were used to improve PM-2.5 emission factors for paved and unpaved roads, wind blown dust, construction, and other fugitive dust sources. The results show that the ratio of fine to coarse PM for fugitive dust should be around 0.1, compared to previous fine to coarse ratios in AP-42 range of 0.15 to 0.4 for most fugitive dust sources.

BACKGROUND

•As part of its stated goals, the WRAP DEJF's initiated several projects to:
- Further the science and understanding of particulate matter in fugitive dust
- Assess and evaluate the relationship and relative importance of fugitive dust with respect to Regional Haze and visibility impairment
- Develop various tools and resources for use by State and Tribes in their Regional Haze SIP development and modeling efforts

•The following WRAP DEJF projects are discussed in this paper:
- Causes of Haze Assessment (COHA);
- Causes of Dust (COD) project;
- Analysis of Fine Fraction of Particulate Matter in Fugitive Dust; and
- Fugitive Dust Handbook and Website

•The inter-relationship of these tools and resources with other WRAP efforts, specifically related to fugitive dust, and their use in the analysis of visibility impairment at Class I areas and Regional Haze SIP development efforts, is illustrated in Figure 1.

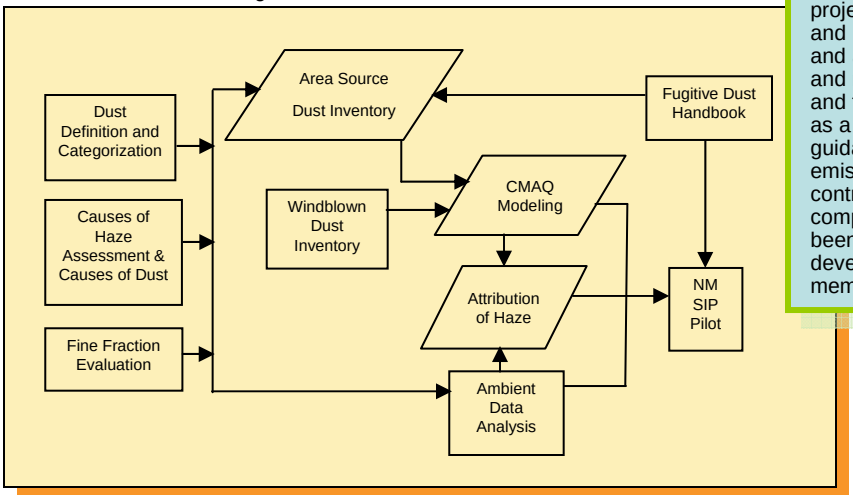


Figure 1. Inter-Relationship of WRAP Dust Forum Projects (adapted from http://www.wrapair.org/forums/dejf/documents/drafts/DEJF_Diagram.ppt)

PM Inventory Developers and Modelers

- The Fugitive Handbook provides AP-42 emission estimation methodologies, including required, or preferred, sources of activity data, for all fugitive dust emission sources
- Alternative estimation approaches are also included in the Handbook
- Handbook provides a single, comprehensive source for emissions factors, estimation methodologies, control technologies and control efficiencies for all fugitive dust sources

SIP Developers

- The results of the COHA and COD projects are important sources of information when developing a "conceptual model" of dust and its visibility impacts
- The Fugitive Dust Handbook is an important source of available control strategies, their effectiveness and related compliance tools

Policy Makers and the Public

- The COHA and COD projects provide clear summaries suitable for policy makers, of the estimated areas and sources of impairment for each Class I area, including the extent of uncertainty about the estimates
- The Fugitive Dust Handbook is a good tool to show that all appropriate control strategies have been considered

WHAT THE DUST EMISSION JOINT FORUM (DEJF) DID:

The DEJF devised and oversaw several projects to support RHR SIP development in the western US. These include:
- Dust Emission Inventory Summary Project
- Windblown Dust Emissions from Vacant Lands
- Dust Tools and Resources (this project)
- Dust Definition Implementation
- New Mexico Pilot SIP Project

There are related "Lessons Learned" papers for all of these projects. The WRAP Dust Tools and Resources were the result of several DEJF funded projects to identify and evaluate the causes of dust and haze throughout the Western US; to re-evaluate and assess the applicability of EPA's test methods and results for the fine fraction of PM in fugitive dust; and to develop a fugitive dust Handbook and Website as a repository of EPA (and other state/local agency) guidance and methodologies for the estimation of emissions from all fugitive dust sources, applicable control methods and their efficiencies and available compliance tools. These tools and resources have been successfully used in Regional Haze SIP development and modeling efforts by various WRAP members and stakeholders

CAUSES OF HAZE ASSESSMENT
&
CAUSES OF DUST

Background

The WRAP has formulated specific questions the answers to which will aid in the execution of its responsibilities. These questions are to be answered by the application of different data analysis methods to existing data sets. The analyses are independent of regional dispersion modeling and help to form the conceptual models on which the regional models are based. Data analyses are intended to be interactive, with products made available on the internet as they are completed. This facilitates feedback on and refinement of the results and presentation methods. The same question may be addressed several times, using different data analysis methods and data bases, to reduce uncertainties and to elucidate phenomena discovered in prior analyses.

Answers to questions were provided for every WRAP and CENRAP Class I Area represented by an IMPROVE site as well as CENRAP and tribal IMPROVE protocol sites that track haze levels. In some cases these were site specific, while in other cases the answers apply to sub-regions that are shown to be affected by the same emission sources and meteorology.

Goals & Objectives

The goal of this project is to answer questions about the chemical components that cause regional haze, relationships of haze to meteorology, the emissions that cause haze, and the effects of previous and future emissions reductions on the poorest and best visibility levels. Specific objectives are to:

- Provide answers to specific questions for each western class I area using several independent data analysis approaches and available data sets.

- Evaluate the uncertainty and generality of these answers by quantitative error analysis, comparison of results from different approaches, and informed judgment.

- Integrate and present results in concise and understandable language that can be used to support WRAP evaluation of and justification for actions that improve western visibility

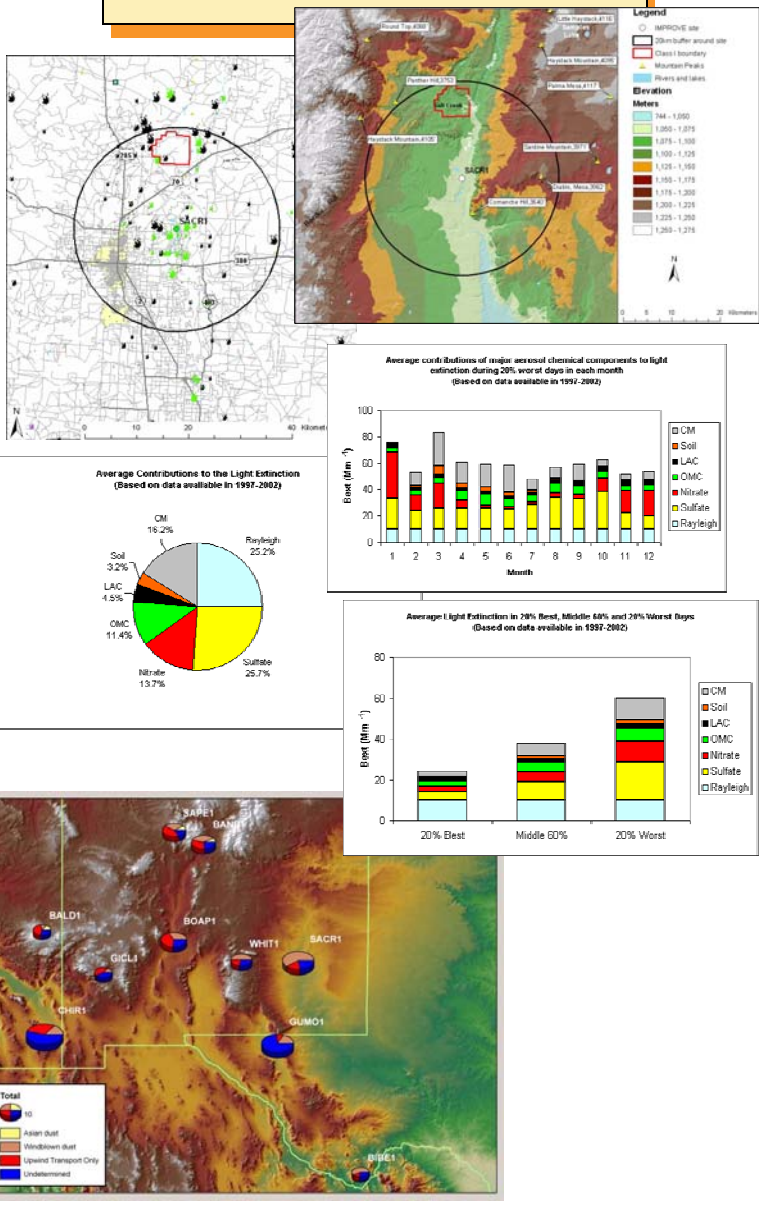
- Identify and quantify sources of airborne dust
  - Local and regional windblown dust
  - Long-range transported dust (e.g. Asia)
  - Wildfire-related dust
  - Other unknown sources

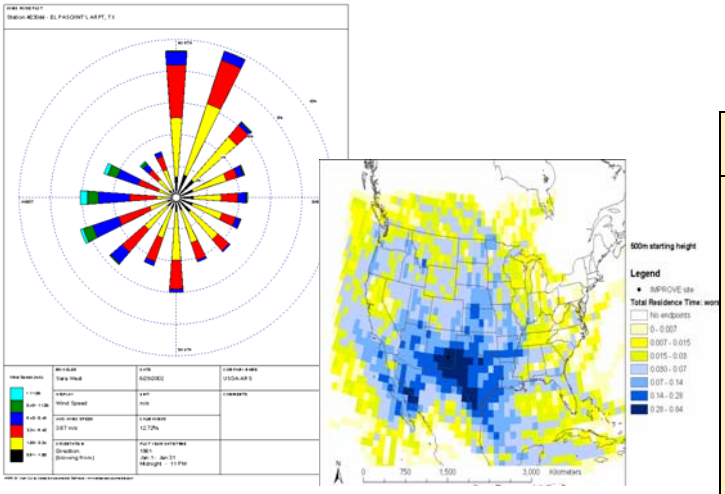
- Post results on the COHA & COD web sites

Technical Approach

Multiple databases were archived for use in the descriptive data analysis. These databases were used to identify emission sources, as well as the precursors of haze particles, to characterize the physical setting for use in meteorological data analysis and to identify existing environmental monitoring networks to help in the data analysis. Supplemental data, tables, and plots were summarized and made electronically available on the COHA web site for more specific examination and display. A variety of assessment methods applicable to determining the causes of haze were implemented for each Class I Area.

The results of these assessments are a series of analysis products, examples of which are presented below





FUGITIVE DUST HANDBOOK & WEBSITE

The Fugitive Dust Handbook and Website were developed for use in technical and policy evaluations by WRAP members, stakeholders, and other interested parties. The handbook and website incorporates available information into a comprehensive document useful to all WRAP members when addressing specific air quality issues and when developing regional haze implementation plans.

The handbook and website provides a comprehensive technical reference for the following fugitive dust source categories:

- Paved Roads
- Unpaved Roads
- Materials Handling
- Wind Erosion From Material Storage Piles
- Construction and Demolition
- Open Area Wind Erosion
- Agricultural Tilling
- Agricultural Wind Erosion

For each fugitive dust source category, the following information is compiled:

- Emission Estimation Methods. Complete text of PM_{10}, $PM_{2.5}$ and $PM_{2.5-10}$ emission estimation methods included in AP-42. Useful methods of obtaining activity level information for the emission estimates, or alternative methods that can be used to improve the emission estimates for these source categories should also be briefly discussed. The user may be referred to other documents for more information on methods not discussed in AP-42.

- Control Techniques. Discuss fugitive dust control methods that have been implemented to reduce or prevent emissions, emission reductions associated with each control method, method for estimating control method cost, range of control measure cost, and cost effectiveness for each control method.

- Fugitive Dust Compliance Tools. Discuss methods used by facility operators and regulators to determine compliance with fugitive dust regulations. Provide examples (and web links) of regulatory language or facility permit conditions used to implement control measures.

FINE FRACTION OF PM IN FUGITIVE DUST

Background

Most of the PM-2.5 emission factors in the US EPA's AP-42 guidance for fugitive dust sources were determined by using hi-volume samplers fitted with a PM-10 cyclone and cascade impactor. Particle bounce on the cascade impactor stages may have resulted in higher PM-2.5 concentrations than the actual conditions. If so, this may help to explain why the AP-42 emission factors for fugitive dust sources appear to overestimate PM-2.5 emissions. In addition, the wind blown dust modeling study conducted for the WRAP assumes an average PM-2.5 to PM-10 ratio of 22% for wind blown dust. This ratio has not been well-documented, but it is a significant assumption used in the windblown dust model.

Technical Approach

Under the same conditions, the PM-2.5 mass for a monitor that measures emissions from a source should be nearly identical to the mass collected using an ambient PM-2.5 sampler that meets US EPA ambient monitoring requirements. A comparison of the PM-2.5 concentrations measured using a hi-volume cascade impactor and the US EPA reference method for PM-2.5 was performed to determine if there is a significant difference. This test should also be performed with US EPA approved PM-10 samplers to evaluate the PM-2.5 to PM-10 ratio for fugitive dust from different geologic sources to help determine if a consistent sampling bias exists. The ratio of PM-2.5 to PM-10 measured in these tests will be useful to help apportion the fine and coarse fractions of particulate matter associated with wind blown dust.

Results

Based on the result of numerous tests, the following findings and conclusions are supported:

- PM2.5 concentrations measured by the high-volume cyclone/impactor system used to develop AP-42 emission factors have a positive bias by a factor of 2.
- The PM2.5 bias associated with the cyclone/impactor system under controlled laboratory conditions closely replicates the bias observed in prior EPA-funded field studies
- The PM2.5/PM10 ratios measured in the current study for a variety of western soils show a decrease in magnitude with increasing PM10 concentrations
- The test data for the current study support a PM2.5/PM10 ratio of 0.1 for typical fugitive dust sources.
- The PM2.5/PM10 ratio of 0.1 is also supported by numerous other studies, included the prior field study that used dichotomous samplers as reference devices

The results of this study are necessary to ensure the development of the most accurate PM fugitive dust emission inventories for regional haze modeling. The results are also useful in developing accurate emission inventories for PM nonattainment, maintenance, and action plan areas within the WRAP region

OTHER RELEVANT POINTS

The WRAP Dust Tools and Resources provide a wealth of data, analysis tools and methodologies to assist state and Tribes in their Regional Haze SIP development efforts

To the extent that the data analysis and modeling efforts to support the development of Regional Haze SIPs will rely on the latest WRAP tools and data resources, the research recommended in the other Dust Lessons Learned papers should be pursued.

RECOMMENDATIONS & FUTURE WORK

The Fugitive Dust handbook should be periodically reviewed and updated with current and recently revised information

The analyses conducted as part of the COHA and COD projects should be reviewed and updated periodically to incorporate the most current ambient monitoring data

Dust emission inventory developers should consult the Fugitive Dust Handbook for the most recent estimation methodologies, emission factors, and data sources

The application of the revised fine fraction dust PM ratios should be a standard practice for emission inventory developers and modelers

Use of the tools and resources available on the COHA and COD websites should considered during PM Dust SIP development efforts

CONTACT INFORMATION

Causes of Haze Assessment Project
Desert Research Institute
http://coha.dri.edu/index.html

Causes of Dust Project
Desert Research Institute
http://www.wrapair.org/forums/dejf/causes.html

Fugitive Dust Handbook and Website
Countess Environmental
http://www.wrapair.org/forums/dejf/fdh/

Analysis of the Fine Fraction of Particulate Matter in Fugitive Dust
Midwest Research Institute
http://www.wrapair.org/forums/dejf/documents/fffd/

WRAP Dust Emission Joint Forum
http://www.wrapair.org/forums/dejf/docs.html

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