Windblown Dust Emissions From Vacant Lands

CONCLUSION STATEMENT:

Estimating windblown dust emissions is not done consistently across the various air agencies in the Western US. The WRAP DEJF funded a project to develop a general methodology and modeling system to estimate PM10 and PM2.5 emissions of windblown dust from vacant lands. This emission inventory was used in a complete comprehensive emission inventory for Regional Haze Modeling efforts in the Western Region of the U.S. The methodology is based on various field studies and general models to predict dust from wind erosion as a function of soil properties and landcover characteristics. Results of the model are highly dependent on the accuracy and detail present within these databases, as well as regional (or local) scale wind fields.

BACKGROUND

WRAP recognized the need for WB Dust inventory in regional haze modeling efforts – previously no dust from wind erosion available on regional-scale

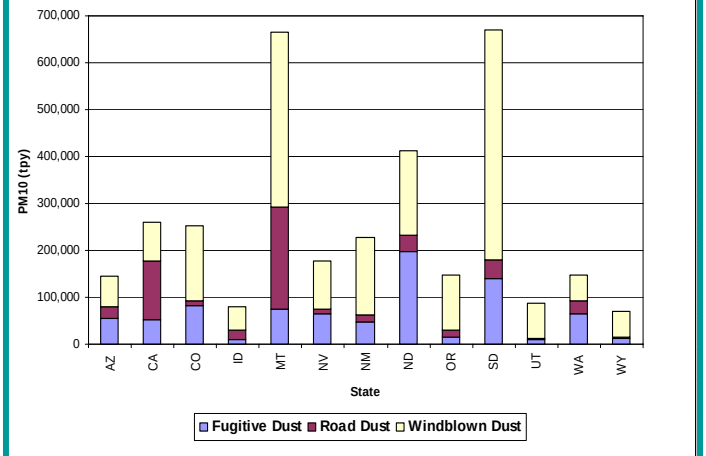
Recognition of relative magnitude and importance with respect to other source categories in regional emission inventories

Consideration of EPA guidance & requirements

DEJF funded a number of studies to investigate and evaluates impacts of dust on visibility and air quality at Western Class I Areas

- Causes of Haze (COHA) project
- Causes of Dust (COD)
- Analysis of Fine Fraction of PM in Fugitive Dust

Phase I & II WB Dust studies funded to develop methodology and modeling system to estimate WB Dust emissions applicable for Regional Haze Modeling



PM Inventory Developers and Modelers

- Provides a regional WB Dust emission inventory for Regional Haze modeling
- Provides an emissions estimation methodology which can be used for small-scale, local applications
- Demonstrates the need for current, local, detailed surface characteristics data

SIP Developers and Policy Makers

- Methodology can be (and has been) used to address Natural Events Policy issues (Salt Lake City area, UT)
- Other successful applications include Imperial Valley, CA & Maricopa Co./Phoenix PM10 Non-Attainment Areas
- Methodology applied for NM Pilot PM10 SIP project
- Used for Dust Definition Feasibility Assessment

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 (this project)
- Dust Tools and Resources (several projects)
- Dust Definition Implementation
- New Mexico Pilot SIP Project

There are related “Lessons Learned” papers for all of these projects. The WRAP Windblown Fugitive Dust model and emission inventory is the culmination of several years of research and investigation of the processes responsible for initiation of wind erosion of soils, the various parameters associated with these processes and the accurate and appropriate characterization of surface characteristics. The result of the project have been used in the regional haze modeling efforts by WRAP, and other RPOs, as well as state and local air quality agencies. Variations and locally-specific enhancements have been made to estimations methodologies and databases used in the modeling system for a number of applications, including the WRAP Dust Definition and New Mexico PM Dust Pilot SIP projects.

Methods & Results

GOALS AND OBJECTIVES

•Development of a general estimation methodology for Fugitive Dust emission from wind erosion of vacant lands

•Development of regional WB Dust emission inventories

•Development and evaluation of the necessary databases for characterization of surface parameters, threshold friction velocities and emission factors

•Investigation of the sensitivity of estimated dust emissions to various model assumptions

•Performance evaluation of regional haze air quality modeling results using regional WB Dust emission inventory

PHASE I STUDIES

•Developed a general methodology and modeling approach/platform

•Identified and evaluated data requirements and sources
- Surface characteristics
  - LULC
  - Soil texture
- Meteorology – MM5; CALPUFF, other
- Agricultural data
  - Crop types
  - Crop calendars
  - Crop management practices – harvesting, tilling, irrigation, etc.
- Emission Factors and threshold velocity relationships

•Utilized a simplified estimation methodology

MODEL SENSITIVITY RESULTS

•Model sensitivity simulations were performed to evaluate effects of soil disturbance and reservoir assumptions

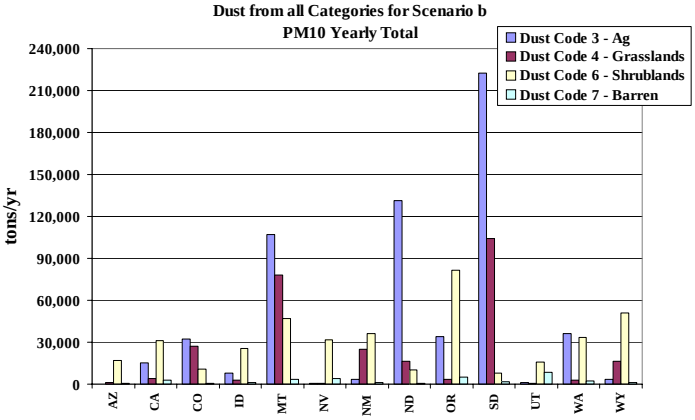
➢Run (a) included no limitation on dust event duration; all soils considered loose undisturbed

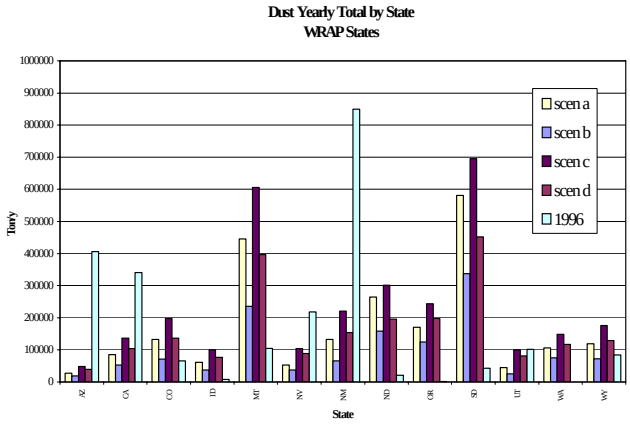
➢Run (b) included dust events limited to 10 hr/day; all soils considered loose undisturbed

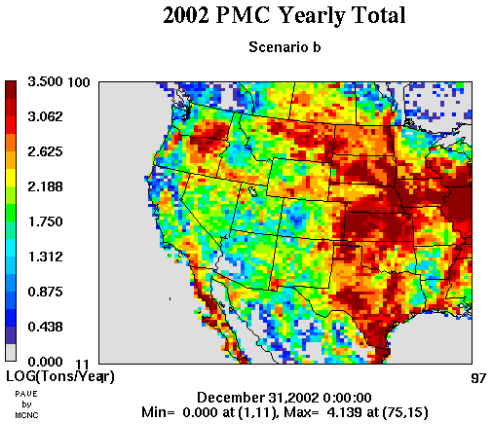
➢Run (c) included no limitation on dust event duration; assume 10% of barren, grass & shrublands area is disturbed; threshold velocity for grass & shrublands = 0.5* undisturbed value; and threshold velocity for barren lands = .27* undisturbed value

➢Run (d) included dust events limited to 10 hr/day for undisturbed soils; assume 10% of barren, grass & shrublands area is disturbed; threshold velocity for grass & shrublands = 0.5 * undisturbed value; and threshold velocity for barren lands = .27 * undisturbed value

Selected model results are displayed below. Assumptions associated with Run (b) were used in all subsequent model applications for the WRAP



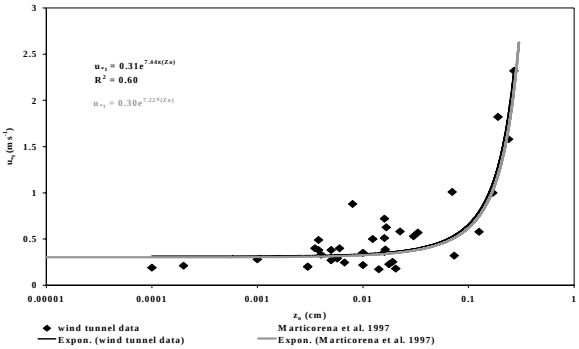


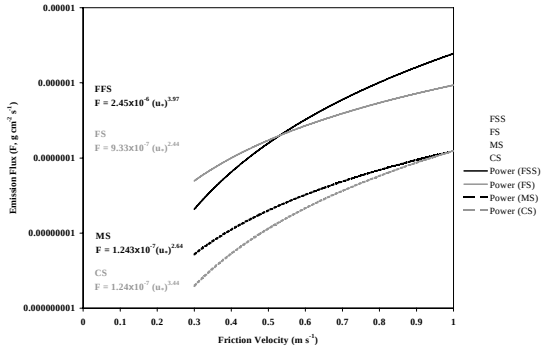


PHASE II STUDIES

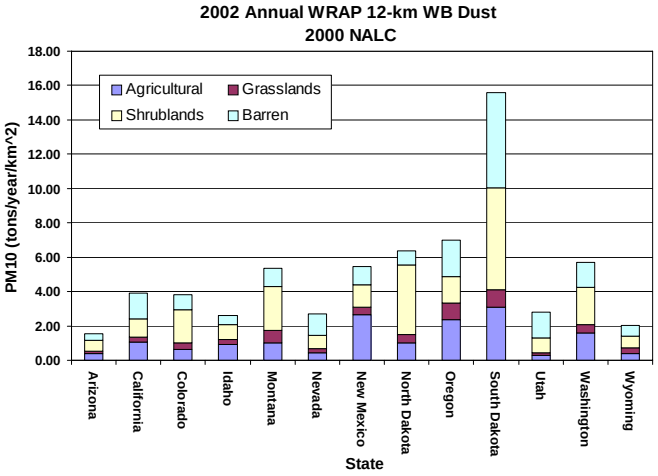
- Reviewed and refined overall objectives
- Conducted literature reviews
  - Global models – Zender, 2003; Draxler et al., 2001; Shao, 2001; Marticorena et al., 1997; Alfaro et a.l, 2003
  - Field studies – Gillette et al, 1988, 1982; Gillette, 1988; Nickling & Gillies, 1989
  - Other wind erosion models - Mac Dougal method; Alfaro, et al, 2003
- Identified and evaluated current updated databases – LULC
- Developed and implemented revised emission estimation methodology
- Sensitivity studies
  - Dust reservoir treatment and assumptions
  - Soil disturbance assumptions
  - LULC)1992 NLCD vs. 2000 NALC)
- Other Model Parameters
  - Transport Fractions
  - Fine/Coarse PM ratios

Threshold Velocities & Emission Rates

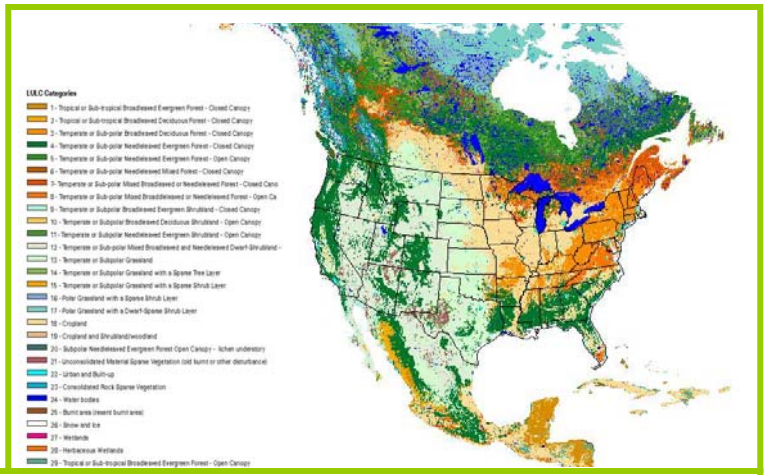


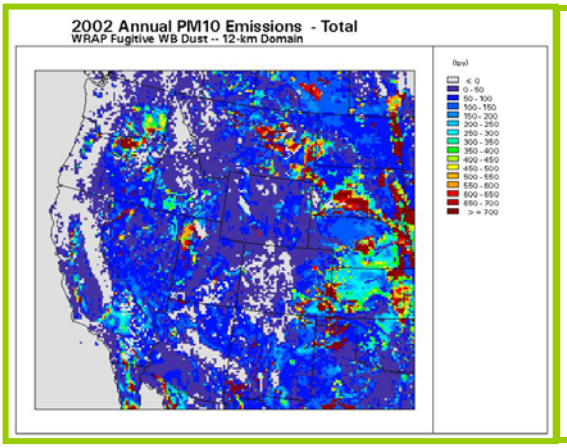


MODEL RESULTS FOR 2002

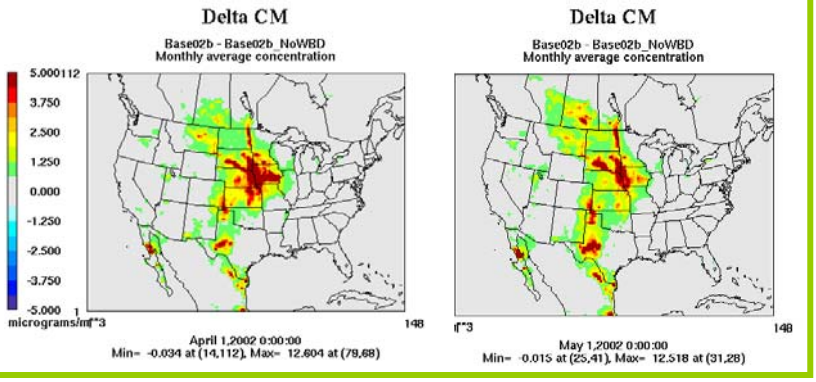


Landuse/Landcover Data





CMAQ MODELING RESULTS FOR 2002



OTHER RELEVANT POINTS AND ISSUES

Numerous assumptions are implemented in the model – need to be reviewed on a case-by-case basis for applicability

Results are highly dependent of accurate and detailed databases

Model limitations are related to regional-scale nature of input data – can be resolved through implementation at small local scale with detailed surface characteristics databases

Additional further research is recommended

RECOMMENDATIONS AND FUTURE WORK

Continued investigation and evaluation of surface characterizations – LULC; Surface roughness parameters, soil disturbance

Identification of local detailed databases

Local scale applications and evaluations

Further investigation into various model assumptions – reservoir characteristics, soils, disturbance levels

Refinement of agricultural data and adjustments – temporal & spatial variations

OTHER APPLICATIONS AND RELATED STUDIES

State/local NEI inventory development & submissions (HI, AR, AZ, WY, NV)

PM Nonattainment Area Maintenance Plans (Phoenix/Maricopa Co.; Imperial Valley, CA)

NEPA applications (Salt Lake City, UT area)

WRAP Dust Definition: Feasibility Assessment and Case Studies

New Mexico Pilot Dust Regional Haze State Implementation Plan for the Salt Creek Wilderness Area

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