Update on REMSAD modeling in support of Regional Haze Rule

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NESCAUM/MANE-VU

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What’s REMSAD model?

- 3-D Eulerian grid model developed by Systems Applications International, Inc. (SAI)

- Nested-grid capabilities and user defined vertical layers

- Simulate both inert and chemically reactive pollutants (micro-CB-IV chemical mechanism)

- Parameterized aerosol chemistry and dynamics for fine and coarse particles Tagging scheme for sulfur, nitrogen, cadmium and mercury
Role of REMSAD modeling

• MANE-VU is building a weight of evidence approach looking at monitoring data, emissions inventory data, regional air-quality modeling and key data analysis findings

• All these techniques have been synthesized and interpreted in an interim “contribution assessment” or pollution apportionment report

• REMSAD is the 2nd most comprehensive model (to CMAQ) with source tagging capability
# REMSAD modeling in Weight of Evidence Approach

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<td>CALPUFF with observation based meteorology</td>
<td>“Source”-based dispersion model</td>
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Previous REMSAD modeling

- Sulfur tagging: Elevated point sources from 32 eastern states only
- USEPA 1996 MM5 meteorology
- National domain with 36km grid
“New” REMSAD modeling platform

• Sulfur source tagging:
  - Elevated & Low level sources from 32 eastern states and Canada  
    (Run 1, 2, 3 -> Still Running)
  - BART-eligible sources (Run 4)
• Boundary Conditions are tagged
• RPO 2002 EI (MANE-VU/VISTAS/MRPO/CENRAP) and 2002 Canadian Inventory
• UMD 2002 MM5 meteorology
• Eastern US domain with 12km grid
REMSAD modeling domain

- 12km Eastern US domain
- 36km National Domain CMAQ run served as BC
REMSAD Emissions by Sources

SO2
Tagged Emissions

Eastern Modeling Domain

[Map of the eastern United States with various regions numbered 1 to 11, marked with red dots indicating emission sources.]
REMSAD concentration

**Ann Avg of TSO4g**

```
XYSUM
g=xsum.TSO4.ann.2002.out
```

**Annual Avg of TSO4g**

```
XYSUM (sum of all tags)
g=xsum.TSO4.ann.2002.out
```

- **January 1, 2002 5:00:00**
  - Min = 0.63 at (15,171), Max = 14.35 at (45,93)

- **January 1, 2002 5:00:00**
  - Min = 0.92 at (94,171), Max = 7.47 at (98,89)
REMSAD performance

IMPROVE/FRM/STN measurement vs. REMSAD (SO4)
REMSAD tagged concentration

Ann Avg of CT's TSO4_1i

Ann Avg of DE's TSO4_2j

Ann Avg of ME's TSO4_3k

Ann Ave of MD's TSO4_4i

Ann Avg of MA's TSO4_5m

Ann Avg of NH's TSO4_6n

January 1, 2002 5:00:00

Min= 0.001 at (91,171), Max= 3.247 at (124,84)

January 1, 2002 5:00:00

Min= 0.001 at (97,171), Max= 1.315 at (153,121)

January 1, 2002 5:00:00

Min= 0.001 at (91,171), Max= 0.919 at (142,131)
REMSAD tagged concentration

**Ann Avg de Non-MANE-VU St**

$T_{SO4\_0h} - XYSUM = xysum.TSO4\_0.ann.2002.out$

$T_{SO4\_0h} = xysum.TSO4.ann.2002.out$ (non-MANE-VU states)

$g = xysum.TSO4.ann.2002.out$ (TSO4 sum of Tags)

**TSO4\_0h/TSO4g**

- Min = 0.874 at (148,170), Max = 5.925 at (91,162)
- Min = 0.358 at (160,155), Max = 0.969 at (91,162)

Maps showing concentration levels in ug/m^3 over the United States.
Location of four class-I areas (receptor site)

- Lye Brook
- Acadia
- Brigantine
- Shenandoah
Contribution analysis
(daily average sulfate concentration)

Acadia NP
Contribution analysis
(daily average sulfate concentration)

Brigantine NWR
Contribution analysis
(daily average sulfate concentration)

Lye Brook Wilderness
Contribution analysis
(daily average sulfate concentration)

Shenandoah NP

August episode
(6th ~16th)
2002 August 6 – 16th episode
(Hourly sulfur plume movement)

Please wait to see animation!
2002 August high O3 episode
(Daily sulfate contribution)

Shenandoah NP
2002 August high O3 episode
(Daily sulfate contribution)

Brigantine NWR
2002 August high O3 episode
(Daily sulfate contribution)

Lye Brook Wilderness
2002 August high O3 episode
(Daily sulfate contribution)

Acadia NP
2002 August 6-16th episode

Shen

Brig.

MV peak

Lybr

Acad

Non-MV peak

SO₄ (ug/m³)
Contribution analysis
(Monthly average sulfate concentration)

Acadia NP

Brigantine NWR
Contribution analysis
(Monthly average sulfate concentration)

Lye Brook Wilderness

Shenandoah NP
 Contribution to PM sulfate in a receptor site

Acadia NP

- non_MV: 71.35%
- Other: 28.65%

- CT: 0.88%
- ME: 7.13%
- MD: 1.31%
- MA: 2.87%
- NJ: 1.58%
- NY: 4.56%
- PA: 6.40%
- RI: 0.34%
- DE: 0.84%
- NH: 2.63%
- VT: 0.13%

Other: 28.65%
Contribution to PM sulfate in a receptor site

Brigantine NWR

non_MV 70.46%
Other 29.54%

CT 0.60%
ME 0.17%
MD 3.21%
MA 0.73%
NH 0.69%
NJ 4.32%
NY 5.18%
PA 11.55%
RI 0.12%
VT 0.06%
Other 29.54%

non_MV 70.46%
Contribution to PM sulfate in a receptor site

Lye Brook Wilderness

non_MV 72.39%

Other 27.61%

CT 0.61%
ME 0.79%
MD 0.31%
MA 1.45%
NH 1.85%
NY 7.77%
NJ 1.55%
PA 10.60%
RI 0.07%
VT 0.97%

Other 27.61%

non_MV 72.39%
Contribution to PM sulfate in a receptor site

Shenandoah NP

non_MV 84.32%

Other 15.68%

CT 0.09%
ME 0.02%
MA 0.08%
NY 1.59%
PA 9.12%
NJ 0.52%
NH 0.08%
RI 0.01%
VT 0.01%
MD 3.64%
DE 0.51%
Ongoing work and anticipated result

- **Continuing Run 2/3**: Finalize State-base contribution analysis (Mid-December)

- **Support NESCAUM’s contribution assessment**: Combine modeling results into integrated analysis framework (Beginning of January)

- **Develop strategy for Run4**: BART-eligible source runs (Mid-January)