Wildland Fire

Preliminary Results of AQ Impact Analysis and Enhancements to the National Emissions Inventory

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US EPA
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Acknowledgements

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- Bill Battye & Kathy Boyer (EC/R)
- Dave Randall (Air Sciences)
- Tom Moore & FEJF (WRAP)
What We’ll Discuss

- Very preliminary results of analysis of fire impact on PM2.5 Air Quality
- EPA’s new *Events Module* for Fires in the NEI
Difference in 24-hr Average PM2.5 June 24 Forecast

Fires – No Fires

Min=-1 at (45,126), Max=144 at (96,97)
Difference in Max 8-hr Ozone for June 25 Forecast
(Fires – No Fires)

June 25, 2005 0:00:00
Min = -6 at (71,112), Max = 30 at (74,121)
Scatter Plots of Max 1-hr Ozone, Max 8-hr Ozone and daily Mean PM2.5 for June / July episode

Note: only model-obs. pairs selected where a fire impact was detected:

O3 (Fire-base) > 4 ppb
PM2.5 (Fire-base) > 2 ug/m3

Legend
• With Fires
• Without Fires
Fire Impacts
Using Ambient Data - Technical Approach

- Screen fire-days in contiguous US for multi-year period
  - Identify PM2.5 AQ monitors w/in 50 mi of each fire
  - Identify nearest met station, WS & WD for each PM2.5 AQ monitor AND each fire location
  - Define
    - Upwind monitor ~ w/in 50 mi of fire AND in 180 deg sector UW
    - Downwind monitor ~ w/in 50 mi AND 90 deg sector DW of fire
- Identify fire-days with PM2.5 AQ monitor pairs:
  - w/ data AND w/in 50 miles upwind & downwind
  - Select monitor pairs with highest UW-DW difference if multiple monitors available on a given fire-day
- Account for “prior bias” between UW & DW monitors
- Summarize DW – UW differences
Skunk Fire (Oregon)
July 25, 2002

7.5 ug/m³

FIRE

73 ug/m³

26 miles
Oregon
July 28, 2002

- Tiller Fire: 6 ug/m³, 40 mi
- Timbered Rock Fire: 65 ug/m³, 40 mi
- Distance: 35 mi
- 57 ug/m³, 57 mi
Improving Fire Data in the NEI

- **Pre - 2002** Fires treated as Non Point
  - Annual estimate, State/County geo-location

- **2002** Fires treated as Point Sources
  - Average daily emissions & 1st-day-of-fire location
  - Snapshot of 2002 – cost to redo prohibitive

- **2003-2006** Fires treated as Point Sources
  - Fire emissions & daily geo-location
  - 1st use of SMARTFIRE…
SMARTFIRE RE - A Hybrid Approach

Advantages, Limitations & Synergies

- **Satellite-derived Data**
  - Available: Fire location, size, date, daily progression
  - R&D Needs: Burn area, Thermal energy, Plume rise
  - Limitations to Overcome:
    - Detection limit (depends on intensity)
    - Cloud interference
    - Understory burns obstructed
    - Conversion of pixels to acres

- **Ground-report Databases**
  - Contains data on fires not detectable by satellite, but...
  - Errors and inconsistencies

- **Hybrid Satellite/ Ground-report Data**
  - 1st Generation: 2003-2006 NEI AND SMARTFIRE RE
  - Needs: Incorporate more ground-report databases
What is SMARTFIRE?

SMARTFIRE uses NOAA Hazard Mapping System satellite fire detects along with ground reports from systems such as ICS-209 reports to create a reconciled fire information data feed.

SMARTFIRE was developed by the USDA Forest Service AirFire Team and Sonoma Technology, Inc. under a grant from NASA.

SMARTFIRE interfaces with the BlueSky framework to estimate daily, location specific fire emissions.

http://www.getbluesky.org/smartfire
## 2003 - 2006 Results (Acres)

<table>
<thead>
<tr>
<th>Model</th>
<th>Year</th>
<th>PB/Unclass Acres</th>
<th>WF Acres</th>
<th>PB/Unclass + WF Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartFire</td>
<td>2003</td>
<td>5,500,480</td>
<td>2,685,580</td>
<td>8,186,060</td>
</tr>
<tr>
<td>SmartFire</td>
<td>2004</td>
<td>6,928,393</td>
<td>900,594</td>
<td>7,828,987</td>
</tr>
<tr>
<td>SmartFire</td>
<td>2005</td>
<td>8,632,472</td>
<td>1,770,942</td>
<td>10,403,414</td>
</tr>
<tr>
<td>SmartFire</td>
<td>2006</td>
<td>8,454,730</td>
<td>3,859,114</td>
<td>12,313,844</td>
</tr>
<tr>
<td><strong>Avg 03-06</strong></td>
<td></td>
<td>7,379,019</td>
<td>2,304,058</td>
<td>9,683,076</td>
</tr>
</tbody>
</table>
Improving the NEI’s Fire EI

- **Pre - 2002** Fires treated as Non Point
  - Annual estimate, State/County geo-location

- **2002** Fires treated as Point Sources
  - Average daily emissions & 1st-day-of-fire location
  - Snapshot of 2002 – cost not sustainable

- **2003-2006** Fires treated as Point Sources
  - Fire emissions & daily geo-location
  - 1st use of SMARTFIRE but…
  - lacks SLT input

- **2008** – Fires in *Events Module* in EPA’s new EI S
<table>
<thead>
<tr>
<th><strong>Component Name</strong></th>
<th><strong>Required/Optional</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td>Required</td>
<td>Identifies the event, reporting land manager, management methods, and data sources.</td>
</tr>
<tr>
<td>Shape File (attach)</td>
<td>Optional</td>
<td>An attached set of geospatial shape files about the event.</td>
</tr>
<tr>
<td>Merged Events</td>
<td>Optional</td>
<td>Identifies discrete fires that merged into the current complex fire event.</td>
</tr>
<tr>
<td>Event Reporting Period</td>
<td>Required</td>
<td>The time period for which emissions are reported.</td>
</tr>
<tr>
<td>Event Location</td>
<td>Required</td>
<td>Identifies the location where the event occurred.</td>
</tr>
<tr>
<td>Geographic Coordinates</td>
<td>Required</td>
<td>Describes geographic location of event using latitude/longitude coordinates.</td>
</tr>
<tr>
<td>GP or GC</td>
<td>Required</td>
<td>Describes geospatial location of event using shape file information.</td>
</tr>
<tr>
<td>Event Emissions Process</td>
<td>Required</td>
<td>Identifies the SCC, fuels, fuel conditions, combustion characteristics, and activity that produced emissions.</td>
</tr>
<tr>
<td>Emissions</td>
<td>Required</td>
<td>Contains information on all the pollutants being reported for the location, process, and time period (Includes the units of measure, methods, emission factors and emissions as calculated)</td>
</tr>
<tr>
<td>Attached File</td>
<td>Optional</td>
<td>References an attached file in the schema.</td>
</tr>
<tr>
<td>Event</td>
<td>Date Range</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>EPA instructions to S/L/Ts on providing fire dates &amp; locations data</td>
<td>Dec 31, 2008</td>
<td></td>
</tr>
<tr>
<td>to SMARTFIRE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deadline for S/L/Ts to provide fire dates &amp; locations to SMARTFIRE</td>
<td>Jul 1, 2009</td>
<td></td>
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<tr>
<td>in order for EPA to model emissions for the 2008 NEI.</td>
<td></td>
<td></td>
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<tr>
<td>EPA develops a national fire emissions inventory for the 2008 NEI</td>
<td>Jul 1 - Oct 1, 2009</td>
<td></td>
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<tr>
<td>using SMARTFIRE's satellite- and ground-based reports, includes</td>
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<tr>
<td>those furnished by S/L/Ts.</td>
<td></td>
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<tr>
<td>EPA's national fire emissions inventory is available on the EIS</td>
<td>Oct 1, 2009</td>
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<td>Gateway for S/L/T review.</td>
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<tr>
<td>SLT's submit alternative fire emissions inventory data to the EIS.</td>
<td>Jul 1, 2009 - Jun 1, 2010</td>
<td></td>
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<tr>
<td>Stakeholders review and comment on draft NEI.</td>
<td>Jul 13 - Nov 1, 2010</td>
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Post-2003-6 Fire EI Development

Next Generation of Hybrid Fire EI Methods

- **Fire Emissions Tracking System (FETS)**
  - WRAP States – on-line this summer

- **State Fire Tracking Systems (FAETS)**
  - e.g., Florida, North Carolina, Georgia, Pennsylvania

- **SMARTFire**
  - Automated integration of Events databases & Satellite data

- **Ongoing Tools Development & Research**
  - BlueSky Framework Enhancements - 3.0 released
  - Improved area burned data from satellite observations (fire radiative power, statistical)
  - Multi-chimney, plume rise - MISR, Calypso
  - Near real-time emissions modeling is here in BETA!
Summary

Evolution of Fire Emissions Estimation

- Pre 2002 ~ simplified, top-down
- 2002 ~ event-based, extensive “cleanup”
- 2003-6 ~ 1st generation hybrid
  - Satellites / event integration from ICS-209 database
- Future ~ 2nd generation hybrid
  - Multiple events databases
  - Improved algorithms to interpret information from satellites
  - Improved fire perimeter & area burned
    - Burned area analysis
    - Improved use of existing sensor spectra (acres/pixel)
  - Improved plume rise estimates
Thank you!

More Info:
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